PAGE'S WEEKLY.—December 30, 1904.
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(REGISTERED AS A NEWSPAPER.)
FRIDAY,
DECEMBER 30, 1904.
No. 16. VOL. 5.
(New Series. No. 12. Vol. I.)

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PAGE'S WEEKLY

ENGINEERING · ELECTRICITY
SHIPBUILDING ◆ MINING
IRON & STEEL INDUSTRIES

EDITORIAL & PUBLISHING OFFICES, CLUN HOUSE, SURREY STREET, STRAND, LONDON, W.C.

FRANCE, Paris: 22, Rue de la Banque.
GERMANY, Berlin: 13, Unter den Linden.
RUSSIA, St. Petersburg: 14, Nevsky Prospect.
ITALY, Rome: 307 Corso.
AUSTRIA, Vienna; Kärntnerstrasse, nr. 30.

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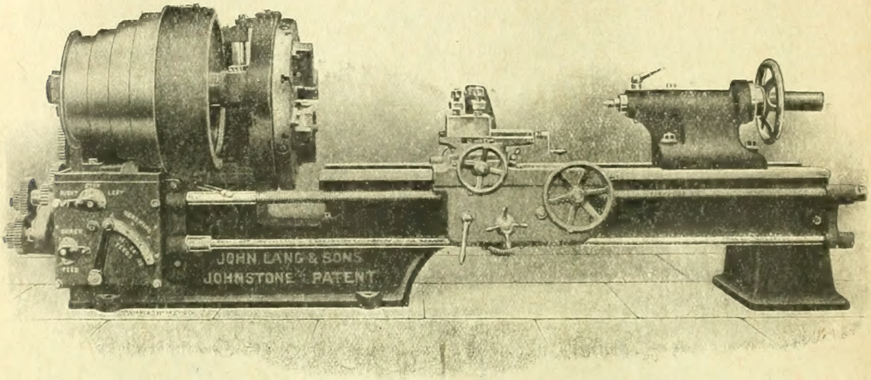
LANG'S HIGH-SPEED LATHES



Have Patent Bed, Patent Loose Head, Patent Screw-Cutting and Feed Motions, also Enormous Power combined with Convenience of Manipulation.

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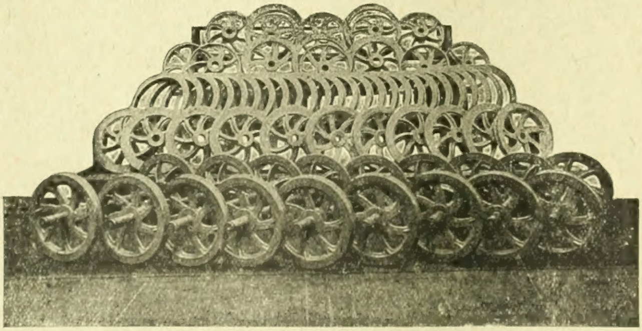

GROUP OF TRAMWAY WHEELS AND AXLES.

HADFIELD'S PATENT "ERA" MANGANESE STEEL
IS THE SUPREME MATERIAL FOR
TRAMWAY POINTS AND CROSSINGS AND CRUSHER WEARING PARTS.

PAGE'S WEEKLY Miscellaneous

Mr. G. H. HUGHES, M.I.Mech.E.,
Consulting and Organising Engineer for Water Works and Industrial Undertakings,
97, QUEEN VICTORIA ST., LONDON, E.C.
Telephone No.: 5754 Bank. Write for particulars.

GRAHAM, MORTON & Co. LTD
Head Office and Works, LEEDS.
Makers and Erectors of all Classes of
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WAYGOOD LIFTS
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WALTER SCOTT, LTD., LEEDS STEEL WORKS, LEEDS, ENGLAND.
MANUFACTURERS OF . . .
Rolled Steel Joists, Channels, etc.
Mild Steel Blooms, Billets, Slabs, Tinbars, Rounds and Flats.
Speciality: TRAMRAILS.

W. R. RENSHAW & Co., Ltd.,
Manufacturers of RAILWAY CARRIAGES, WAGONS, WHEELS & AXLES, and all classes of RAILWAY IRONWORK.
RAILWAY WAGONS FOR HIRE.
PHŒNIX WORKS, STOKE-ON-TRENT.
London Office: 46, KING WILLIAM STREET, E.C.

BABCOCK & WILCOX, Ltd.
PATENT WATER-TUBE BOILERS.
These Boilers are in use throughout the world to the extent of 4,700,000 h.p., generating steam for all purposes, and fired with all kinds of fuel.
See our Advertisement appearing January 20th, page 45.
HEAD OFFICES—Oriel House, Farringdon Street, LONDON, E.C.
WORKS—Renfrew, SCOTLAND.

HARTLEY & SUGDEN, LIMITED, HALIFAX. TRADE MARK H & S Hx
Heating Apparatus
BOILERS
Wrot Welded Iron and Cast Iron Sectional
VERTICAL STEAM BOILERS
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PAGE & ROWLINGSON,
Chartered Patent Agents.
Mr. PAGE, who is a Whitworth Exhibitioner and an Associate Member of the Institute of Civil Engineers, has had a large experience as a Practical Mechanical Engineer, and is specially qualified to deal with the most intricate mechanical problems successfully. *Write for Handbook of Information Free.*
28, NEW BRIDGE STREET, LONDON, E.C.,
And 14, St. Ann's Square, Manchester.

McINNE'S PATTERN.

HIGH SPEED INDICATORS.
Hannan & Buchanan,
75, Robertson Street, Glasgow.
ENGINE COUNTERS.
BOURDON GAUGES.
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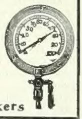
Engineering Instrument Makers



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Chips and Saw-dust FIRELIGHTERS.
GLOVER'S PATENT MACHINERY
ENORMOUS Saves 12 to 80 Men's Work. PROFITS
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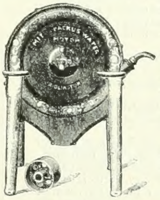

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SMITH'S
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1/16 to 10 H.P.
Will drive any class of Machinery, and work on 15 lb. pressure.
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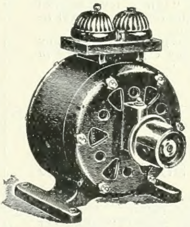

Alternating Current Motors,
IN SMALL SIZES.
THE CRYPTO ELECTRICAL CO.,
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BERMONDSEY.
Telephone No. 12830 Central.

ENGINEERING PHOTOGRAPHY
Price List on application to—
BOOKER & SULLIVAN,
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Telephone: 9252 Central.

PAGE'S WEEKLY Contracts

CONTRACTS.

ASYLUMS COMMITTEE OF LONDON COUNTY COUNCIL.

The Asylums Committee of the London County Council are prepared to receive TENDERS for the INSTALLATION of HEATING, VENTILATING, and HOT-WATER PLANT at the Long Grove, Asylum, Epsom, Surrey, now in course of erection.

Instructions for Tender and forms of Tender and Contract, with specification and schedules thereto annexed, together with plans and cover, can be obtained from the Clerk of the Committee, No. 6, Waterloo Place, London, S.W., on or after Thursday, the 1st December proximo, on payment of a deposit of £5 for each copy. The amount deposited will, after the Committee have come to a decision upon the Tenders received, but not before, be returned to the tenderer, provided he shall have sent in a *bonâ fide* Tender and shall not have withdrawn the same.

Tenders must be on the printed form, and must be accompanied by the form of contract and schedules thereto and bond.

The Tender and accompanying documents, completed in accordance with the instructions, must be enclosed in the authorised sealed cover, endorsed "Tender for Heating, Long Grove Asylum," and be delivered at the Office of the Committee, 6, Waterloo Place, London, S.W., on or before Monday, the 23rd January, 1905, after which no Tender will be received.

Any Tender not made on the printed form, or not filled up and complete in every particular in accordance with the instructions, will be rejected.

The Committee do not bind themselves to accept the lowest or any Tender.

The contractor will have to enter into a bond in the penal sum of £2,000, with two approved sureties, each in the sum of £1,000, as security for the due performance of the contract.

R. W. PARTRIDGE,
Clerk of the Asylums Committee.

Asylums Committee Office,
6, Waterloo Place, London, S.W.,
November 16th, 1904.

GREAT WESTERN RAILWAY.—The Directors of this Company are prepared to receive TENDERS for the SUPPLY and DELIVERY of the following MATERIAL required in connection with the Electrical Equipment of the Hammersmith and City Railway, &c.:—

SPECIFICATION No. 8.—Steel Conductor Rails, Cast Iron and Steel Ramps and Fastenings.

SPECIFICATION No. 9.—Porcelain Insulating Supports, and their Fastenings for Conductor Rails.

SPECIFICATION No. 10.—Copper Bonds, Insulated Cable Connections, Cable Terminals, Bonding Presses and Accessories for connecting up Conductor Rails.

Copies of the specifications, forms of Tender, drawings, and general conditions, can be obtained, on and after Saturday, the 10th inst., except between the 23rd and 27th inst. inclusive, at the Offices of the Consulting Engineers, Messrs. KENNEDY AND JENKIN, 17, Victoria Street London, S.W., between the hours of 10 a.m. and 4 p.m. on payment of Two Guineas for each specification, which will be refunded on the receipt of a *bonâ fide* Tender.

The fee, which must be paid by cheque, will not be returnable until the Tenders have been adjudicated upon.

Tenders, addressed to "The Secretary, Great Western Railway, Paddington Station, W.," and marked outside "Tender for Electrical Equipment, Specification No. 8, 9, or 10," as the case may be, will be received on or before Tuesday, the 3rd proximo.

The Directors do not bind themselves to accept the lowest or any Tender, and no allowance will be made for any expense incurred in the preparation of the Tender.

Paddington Station, London, G. K. MILLS,
December 7th, 1904. Secretary.

EAST INDIAN RAILWAY.

The East Indian Railway Company is prepared to receive

TENDERS FOR THE SUPPLY AND DELIVERY of :—

STEEL MATERIAL (Plates, Bars, Joists, &c.),

as per specification to be seen at the Company's Offices.

Tenders are to be sent to the undersigned, marked "Tender for Steel Material," not later than Twelve o'clock noon on Wednesday, the 4th day of January, proximo

The Company reserves to itself the right to divide the order, also to decline any Tender without assigning a reason, and does not bind itself to accept the lowest or any Tender.

For each specification a fee of £1 1s. is charged, which cannot under any circumstances be returned.

By order,
C. W. YOUNG,
Nicholas Lane, London, E.C., Secretary.
December 15th, 1904.

BOROUGH OF CAMBERWELL.

TO BRIDGE BUILDERS, BUILDERS, CONTRACTORS, AND ENGINEERS.

The Council is prepared to receive

TENDERS FOR THE CONSTRUCTION and ERECTION of a FOOTBRIDGE and APPROACH ROADS, &c., over the Surrey Canal, between Neate Street and St. George's Road, Camberwell, in accordance with the Plans and Specifications prepared by the Borough Engineer, Mr. WILLIAM OXTOBY.

Tenders, on forms for the purpose, are to be delivered, duly marked and sealed and addressed to the Works and General Purposes Committee, not later than 6.30 p.m. on Monday, January 23rd, 1905, after which time no Tender will be received. Persons tendering should be in attendance.

A deposit of £2 2s. will be required for a copy of the Specifications and Quantities, the sum to be returned on receipt of a *bonâ fide* Tender. Further particulars and Forms of Tender, &c., may be obtained at the Town Hall, Camberwell, between the hours of Ten a.m. and Four p.m., Saturday Ten a.m. to One p.m.

The Council does not bind itself to accept the lowest or any Tender. Persons tendering must comply with the Conditions as regards rates of wages and hours of labour as contained in the Form of Contract.

C. WILLIAM TAGG,
Town Clerk.

December 19th, 1904.

BOROUGH OF KIDDERMINSTER

WATER SUPPLY.—CONTRACT No. 3.

The Corporation of Kidderminster is prepared to receive TENDERS for the ERECTION of ENGINE-HOUSE, BOILER-HOUSE, and CHIMNEY STACK, together with the PROVISION, LAYING, and JOINTING of about 800 YARDS of 10 in. CAST IRON DISTRIBUTING MAIN, and other works in connection therewith.

Plans and Specifications may be seen, and bills of quantities obtained, at the Offices of the Engineers, Messrs. Willcox and Raikes, of Union Chambers, 63, Temple Row, Birmingham, on or after December 30th, upon payment of a deposit of £5 5s., which will be refunded on receipt of a *bonâ fide* Tender and the return of all documents.

Sealed Tenders, on the forms supplied by the Engineers, and endorsed "Kidderminster Water Supply.—Contract No. 3," to be delivered at my office not later than Twelve noon on January 20th, 1905.

The Corporation do not bind themselves to accept the lowest or any Tender.

By order,
JAMES MORTON,
Town Hall, Kidderminster, Town Clerk.
December 19th, 1904.

PORT ELIZABETH MUNICIPAL CORPORATION ELECTRICITY SUPPLY.

The Agents of the Municipal Corporation of Port Elizabeth, South Africa, are prepared to receive TENDERS for the EXECUTION of the following WORKS in connection with the Corporation Electricity Supply undertaking: Section A. Boiler-house Plant—Three marine type water-tube boilers, superheaters, economisers, chimneys, pipework, tanks, electrically driven feed pumps and accessories. Section B. Engine-room Plant—Three 400 kilowatt steam turbines and dynamos, surface condensers, electrically driven pumps, pipe work and accessories. Section C. Electricity Supply Mains—Cables, pillars, boxes and accessories. Section D. Accumulators and Boosters—Battery of accumulators, reversible boosters, milking booster and accessories. Section E. Switchboard and Instruments—Main and auxiliary switchboards, instruments, apparatus and accessories. Section F. Crane—Ten-ton overhead hand travelling crane. Section G. Public Lighting—Ten-ampère arc lamps, three-ampère enclosed arc lamps, Nernst lamps, arc pillars, brackets and accessories. Section H. Meters—Motor and electrolytic meters. Section I. Workshop Equipment—Machine tools, motor, fitters', smiths', and joiners' tools, lifting gear, mains department equipment.

Applicants must state for which section or sections they wish to tender, in order that the requisite drawings may be forwarded to them. Tenderers are at liberty to tender for any one of or for all the sections, but not for part of a section. The specification, with terms and conditions, forms of tenders and form of contract, may be obtained from the undersigned, on making a deposit of £5 5s., which sum will be refunded on the return of the specification filled up with a *bonâ fide* Tender. Extra copies of the specification may be obtained by *bonâ fide* tenderers at a charge of Five Shillings per copy, which will not be refunded. Tenders (sealed and marked "Tender for Electrical Plant") must be delivered to the undersigned before noon on Monday, January 16th, 1905.

The Municipal Corporation does not bind itself to accept the lowest or any Tender.

DAVIS and SOPER,
Agents to the Municipal Corporation of
Port Elizabeth, South Africa.

54, St. Mary Axe, London, E.C.

PAGE'S WEEKLY Contracts

URBAN DISTRICT OF ERITH.
TRAMWAYS.
The Erith Urban District Council invite

TENDERS FOR:—

CONTRACT No. 5.
OVERHEAD LINE EQUIPMENT, POLES, &c.
CONTRACT No. 6.
UNDERGROUND FEEDER CABLES, BOXES, &c.
CONTRACT No. 7.
ROTARY CONVERTERS, TRANSFORMERS and MOTOR BOOSTER.
CONTRACT No. 8.
MAIN HIGH and LOW-TENSION SWITCHBOARDS, CABLE CONNECTIONS, &c.

Copies of specifications with forms of Tender, general conditions, &c., may be obtained from the undersigned, on depositing the sum of £5, which sum will be returned on receipt of a *boná fide* Tender.

Plans and specifications may be seen at, but not obtained from, the offices of Messrs. **HAWTAYNE AND ZEDEN**, of 9, Queen Street Place, London, E.C., the Consulting Engineers to the Council.

The contract will provide that the Contractor shall pay not less than the standard rates of wages, and observe the conditions of labour customary in the district where the work is executed.

Persons tendering are at liberty to Tender for either or all of the contracts, but not for part only of one contract.

Tenders, sealed and marked "Tramways Contract No.........Tender," to be addressed to the undersigned, and delivered at or before Twelve o'clock Noon on Monday, the 9th day of January, 1905.

Dated this 9th day of December, 1904.

CHARLES H. FRY,
Clerk of the Council.

District Council Offices, Erith, Kent.

CRICKLADE AND WOOTTON BASSETT RURAL DISTRICT COUNCIL.
TO CONTRACTORS.
CRICKLADE WATER SUPPLY.—CONTRACT No. 1.
The above Council invite

TENDERS FOR THE CONSTRUCTION

and MAINTENANCE of WORKS for supplying the Town of Cricklade with water.

This contract comprises the CONSTRUCTION of a CONCRETE COLLECTING TRENCH, BRICK ENGINE HOUSE and STORE, CONCRETE FILTERS and TANKS, and COVERED SERVICE RESERVOIR of about 50,000 gallons capacity.

PROVIDING, LAYING and JOINTING about 4,000 yards of 4 in. and about 2,300 yards of 3 in. CAST IRON MAINS and BRANCHES, with Valves, Hydrants and Fittings, and other work in connection therewith.

Persons desiring to submit Tenders may see the plans, sections, and specification, and obtain a copy of the schedule of quantities and form of Tender and other particulars, upon application to the Engineer Mr. F. REDMAN, 34, Wood Street, Swindon, Wilts., and upon payment of the sum of Five Guineas, on and after the 15th instant, between the hours of Ten a.m. and Five p.m. (Saturdays, Sundays, and 26th instant excepted).

The deposit will, after the Council have come to a decision upon the Tenders received, be returned to contractors who have sent in a *boná fide* Tender, with the schedule of quantities properly priced and signed in ink.

The contractor whose Tender is accepted will have to enter into a formal agreement, under seal, with approved sureties for £500, for the due performance of the contract.

The Council does not bind itself to accept the lowest or any Tender, nor to pay any expenses incurred by parties tendering.

Sealed Tenders, endorsed "Cricklade Water Supply," must be delivered at my Office not later than Noon on Tuesday, January 3rd, 1905.

By order,
(Signed) H. BEVIR,
Wootton Bassett, December 7th, 1904. Clerk to the Council.

JOHANNESBURG MUNICIPAL TRAMWAYS.
The Council is prepared to receive

TENDERS FOR:—

VIGNOLES RAILS.
FISHPLATES.
ANGLE STEEL GUARD RAILS, BOLTS, NUTS, COACH SCREWS and DOG SPIKES.

General conditions, specifications, and forms of Tender are now being issued at the Offices of the Town Clerk of Johannesburg. They may be seen on and after Friday, December 30th, at the Offices of the Council's Consulting Engineers, Messrs. MORDEY AND DAWBARN, 82, Victoria Street, Westminster, S.W., and may be obtained from them on payment of Five Guineas, which will be returned on receipt of a *boná fide* Tender.

Tenders are to be addressed to Messrs. MORDEY AND DAWBARN, 82, Victoria Street, Westminster, S.W., and must reach them not later than Noon on Thursday, January 26th, 1905.

The Council does not bind itself to accept the lowest or any Tender, and is not responsible for the cost of Tendering.

R. FEETHAM, Town Clerk.

MANSFIELD WOODHOUSE SEWERAGE.

The Mansfield Woodhouse Urban District Council are prepared to receive TENDERS from competent contractors willing to enter into a contract for the CONSTRUCTION of SEWERAGE and SEWAGE DISPOSAL WORKS for their district, comprising a 12 in., 15 in., and 18 in. Main Intercepting and Outfall Sewer, Two Brickwork Storage Tanks, Pumping Station Buildings and Machinery, Pumping Main, and Laying Out about 45 acres of land for the disposal of the Sewage, together with all Manholes, Valves, and other appurtenant works.

The drawings and specification may be seen at the Loughborough office of the Engineers, Messrs. GEORGE AND F. W. HODSON, and schedule of quantities and Tender form may be obtained from them on deposit of a cheque for £5 5s., which will be refunded to every person making a *bona fide* Tender, on the return of the documents entrusted to him.

In the event of a Tender being withdrawn, the deposit will be forfeited.

Sealed Tenders, endorsed "Tender for Sewerage Works," are to be sent to the undersigned so as to arrive not later than Monday, January 2nd, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

Dated this 7th day of December, 1904.

J. E. ALCOCK,
Mansfield, Notts. Clerk to the Urban Council.

APPOINTMENTS OPEN.

MARTELL SCHOLARSHIP IN NAVAL ARCHITECTURE.

A SCHOLARSHIP of the annual value of £50, and subject to certain conditions, tenable for three years, will be OFFERED for COMPETITION by the Institution of Naval Architects.

Candidates must not be less than 18 or more than 21 years of age on March 1st, 1905, and must at that date have been continuously employed for two years upon naval architecture or marine engineering.

Further particulars may be obtained from the SECRETARY of the Institution of Naval Architects, 5, Adelphi Terrace, London, W.C. (envelopes to be marked "Martell Scholarship").

Applications must be sent in by February 1st, 1905.

BURNHAM URBAN DISTRICT COUNCIL (SOMERSET).

APPOINTMENT OF DISTRICT SURVEYOR, INSPECTOR OF NUISANCES, AND WATERWORKS MANAGER.

The above Council will, at a meeting to be held on Monday, the 16th day of January, 1905, be prepared to consider APPLICATIONS from PERSONS DESIROUS of FILLING the above OFFICES.

The salaries will be as follows, viz.: District Surveyor, £50 per annum; Waterworks Manager, £10 per annum; Inspector of Nuisances, £60 per annum.

The person appointed to hold the three offices.

The appointment of Inspector of Nuisances will be subject to confirmation by the Local Government Board.

The duties of the offices will be those prescribed by the Public Health Acts, the regulations of the Local Government Board, and the By-laws now or hereafter to be in force and adopted by the Urban Council, and will commence at Lady Day next.

The person appointed will be required to reside in the district, and to give the whole of his time to his duties.

Sealed applications in candidate's own handwriting, stating age and present and previous occupations, with recent testimonials as to character and competency, not more than three in number, must be sent to me on or before Saturday, the 14th day January next.

The Council do not bind themselves to appoint any applicant.

Candidates who may be selected to attend the Council on the day of appointment will receive due notice.

Canvassing will disqualify a candidate.

By order,
D. S. WATSON,
Clerk to the Council.

THE VICTORIA UNIVERSITY OF MANCHESTER.

The Council desires to proceed to the APPOINTMENT of a PROFESSOR of ENGINEERING.

The Professor will be responsible for the organisation of the Engineering Department, and will have the direction of the Engineering Laboratory.

He may take a consulting practice under specified conditions.

His stipend will be composed of a fixed salary and a share of the fees, and the Council guarantee that the total income will not be less than £1,000 per annum during the first three years.

A detailed statement of the conditions of appointment may be obtained from the Registrar.

Applications, with references and such testimonials (not exceeding three in number) as the candidate may desire, should be sent on or before February 15th to the Registrar.

BUYERS' DIRECTORY.

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages 23 and 25.*

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. for each additional section.

Artesian Well Machinery.
John Z. Thom, Patricroft, Manchester.

Belting.
Binney & Son, Catherine Street, City Road, London, E.C.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Gilmour, W. & O., St. John's Hill, Edinburgh.
Rossendale Belting Co., Ltd., 10, West Mosley Street, Manchester

Boilers.
Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Grantham Crank & Iron Co., Ltd., Grantham.
John Thompson, Wolverhampton.

Boilers (Water-tube).
Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.
Cochran & Co. (Annan), Ltd., Annan, Scotland.
Hartley & Sugden, Ltd., Halifax.

Bolts, Nuts, Rivets, etc.
Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

Books.
Crosby Lockwood & Son, Stationers' Hall Court, London, E.C.
Griffin, Charles, & Co., Exeter Street, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.
Spon, E. & F. N., 125, Strand, W.C.

Cables.
St. Helen's Cable Co., Ltd., Warrington, Lancashire.

Case-Hardening Compounds.
Hy. Miller & Co., Millgarth Works, Leeds.

Catalogues, Printing, &c.
Atlantic Press, Ltd., Weymouth Street, Manchester.
Southwood, Smith & Co., Ltd., Plough Court, Fetter Lane, London, E.C.
Spottiswoode Advertising Agency, 8, New Street Square, E.C.

Chucks.
Fairbanks Co., 78-80, City Road, London, E.C.

Cisterns, Tanks, &c.
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Clutches (Friction).
David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.
H. J. H. King & Co., Nailsworth, Gloucestershire.

Colliery Plants.
Graham, Morton & Co., Ltd., Leeds.

Condensing Plant.
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirrlees-Watson & Co., Ltd., Glasgow.

Condensed Water Purifiers.
Lassen & Hjort, 52, Queen Victoria Street, London, E.C.

Consulting Engineers.
Gibbs, John, & Son, 80, Juke Street, Liverpool.
G. H. Hughes, A.M.I.M.E., 97, Queen Victoria Street, London, E.C.

Continental Railway Arrangements.
South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.
Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Brown Hoisting Machinery Co., 39, Victoria Street, London, S.W.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Graham, Morton & Co., Ltd., Leeds.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Coverings (Boiler).
Magnesia Coverings, Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.
Joseph Booth & Bros. Ltd, Rodley, Leeds.
Thomas Broadbent & Sons, Ltd., Huddersfield.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Cranks.
Clarke's Crank & Forge Co., Ltd., Lincoln, England.

Cutters (Milling).
E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham

Destructors.
Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.
Delange & Cie. Mce., Hoboken, near Antwerp.
Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

Economisers.
E. Green & Son, Ltd., Manchester.

Ejectors (Pneumatic).
Hughes & Lancaster, 47, Victoria Street, London, S.W.

Electrical Apparatus.
Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Bruce Peebles & Co., Ltd., Edinburgh.
Brush Electrical Engineering Co., Ltd., Victoria Works Belvedere Road, London, S.E.
Crompton & Co., Ltd., Arc Works, Chelmsford.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Batley, Ltd., Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., The Silvertown, London, E.
Mather & Platt, Ltd., Salford Iron Works, Manchester.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34, Queen Street, London, E.C.
Newton Brothers, Full Street, Derby.
Phœnix Dynamo Manufacturing Co., Bradford, Yorks.
Premier Electrolyte Co., 26, Spital Square, London, E.
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Hudswell Clarke & Co., Ltd., Leeds, England.

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Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London E.C.
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Momentum Engine, 19, 19a, Imperial Buildings, Ludgate Circus, London, E.C.
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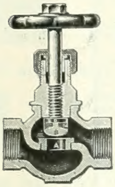

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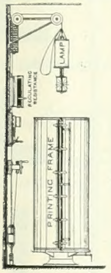

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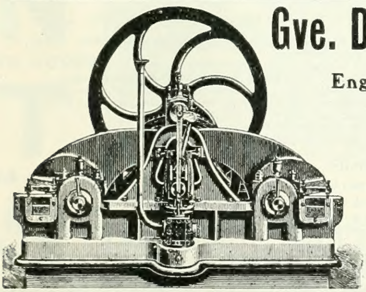

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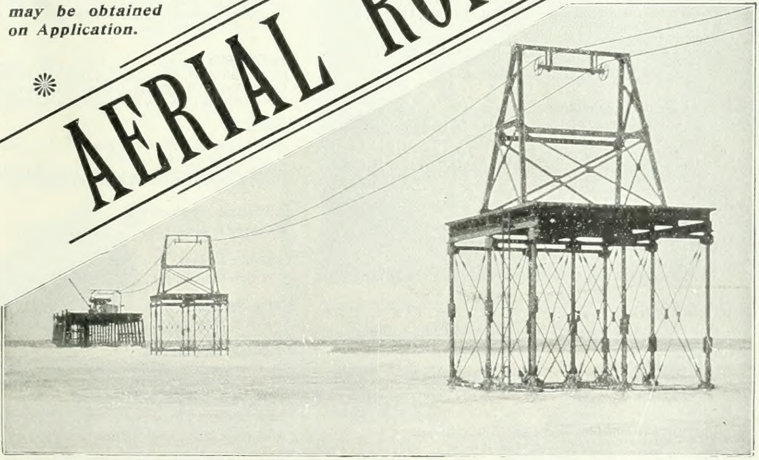

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Publishers.

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Charles Griffin & Co., Ltd., Exeter Street, Strand, London, W.C.
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New Zealand Mines Record, Wellington, New Zealand.

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H. J. H. King & Co., Nailsworth, Glos.

Pumps and Pumping Machinery.

Blake & Knowles Steam Pump Works, Ltd., 153, Queen Victoria Street, London, E.C.
Drum Engineering Co., 27, Charles Street, Bradford.
Enke, Carl, Schkeuditz-Leipzig, Germany.
Fairbanks, Morse & Co., 126, Southwark Street, London, S.E.
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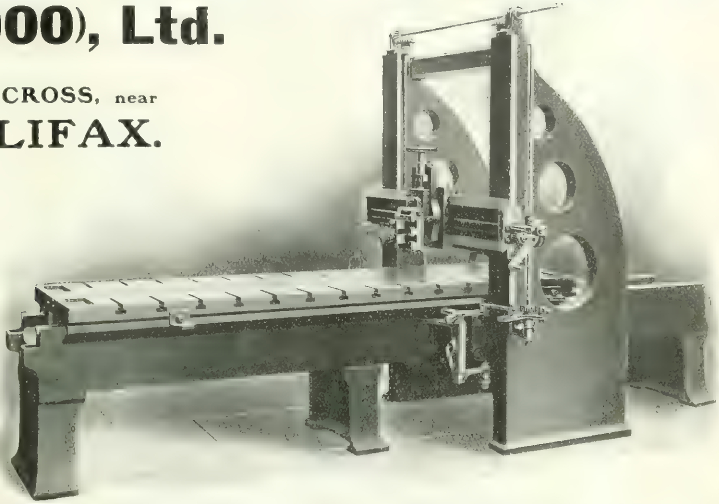

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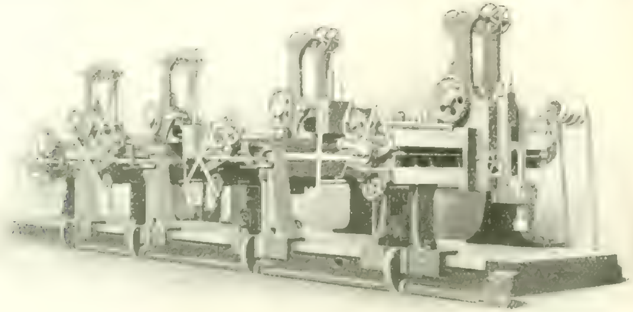

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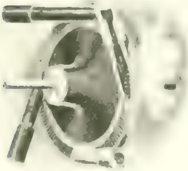

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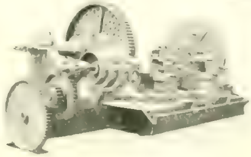

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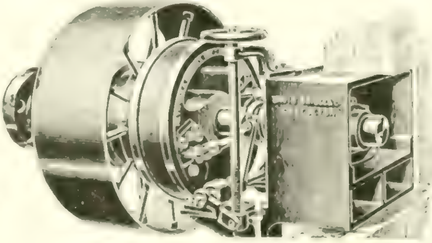

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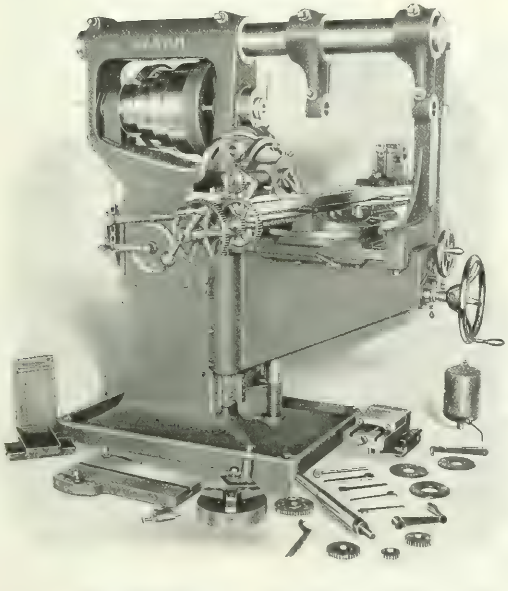

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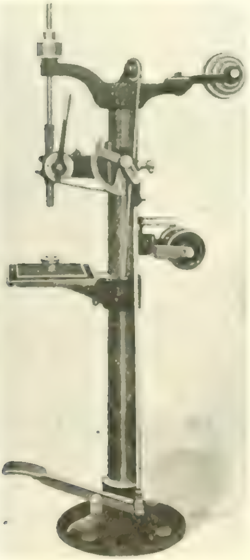

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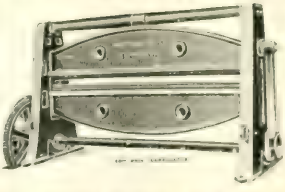

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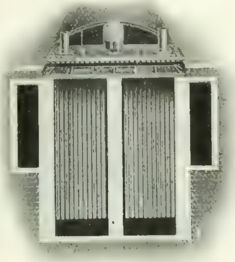

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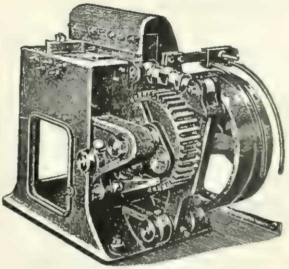

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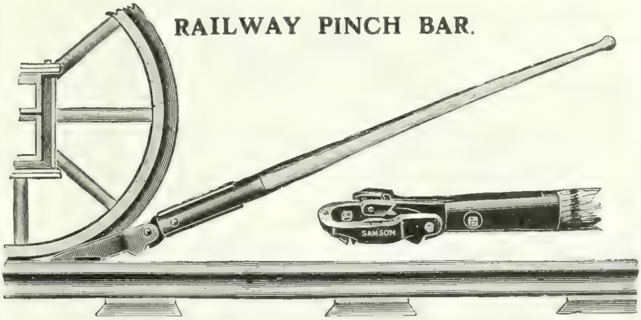

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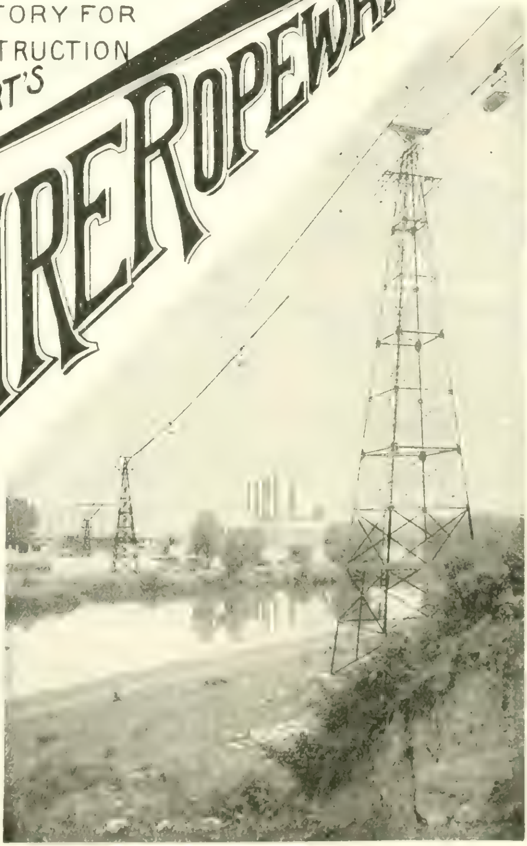

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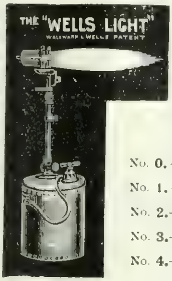

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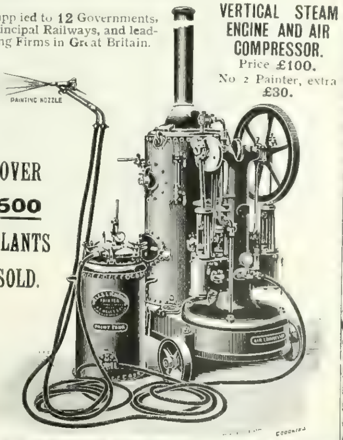

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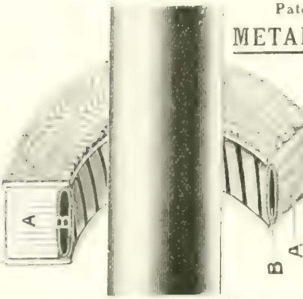

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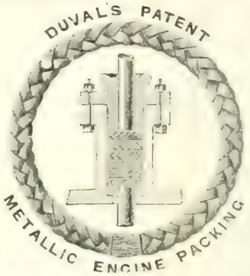

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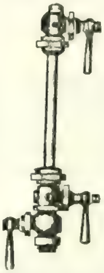

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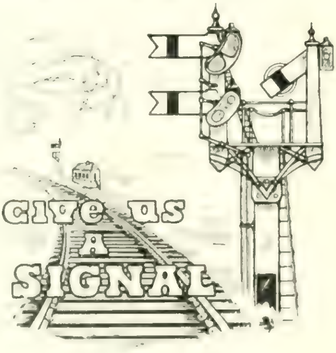

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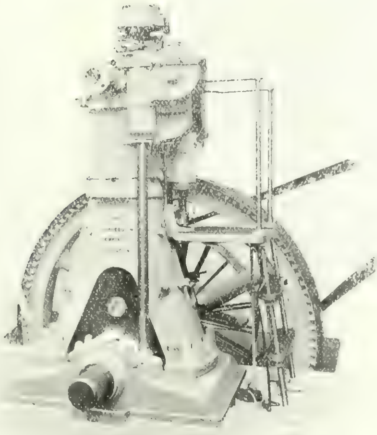

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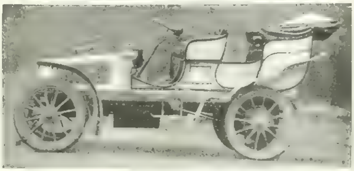

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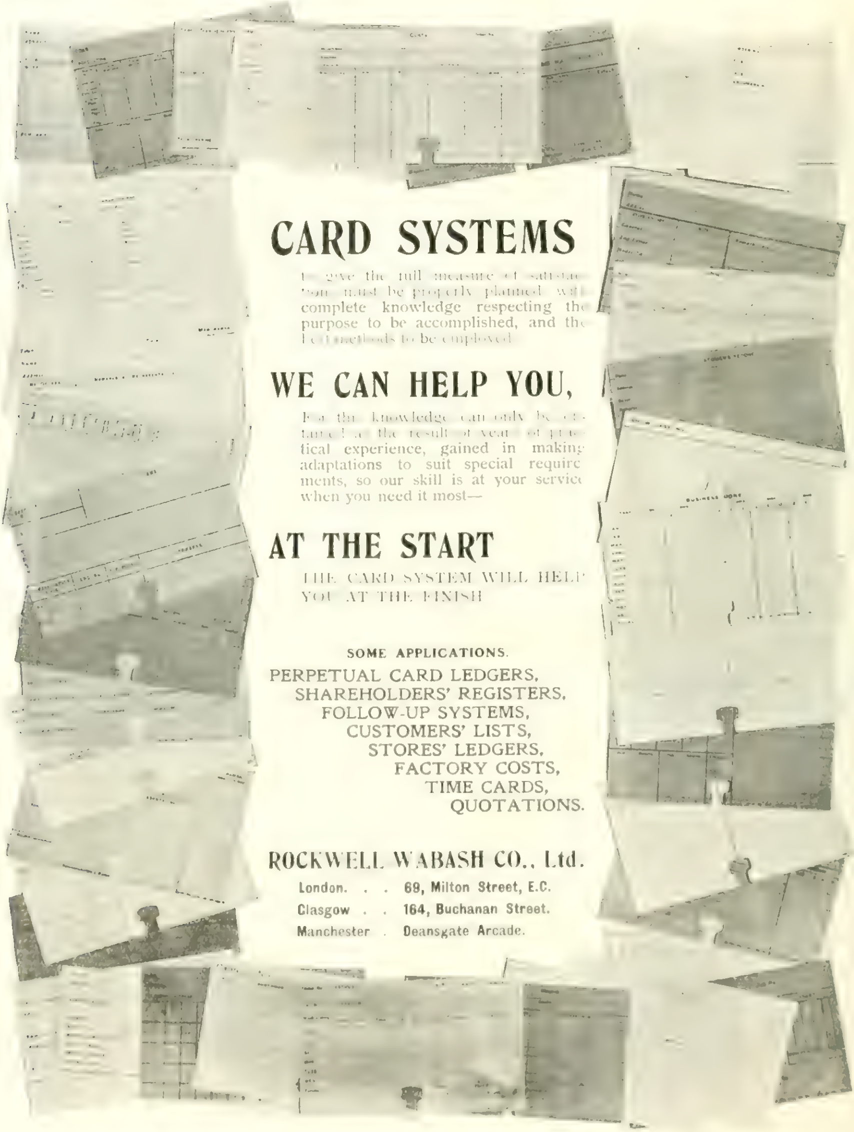

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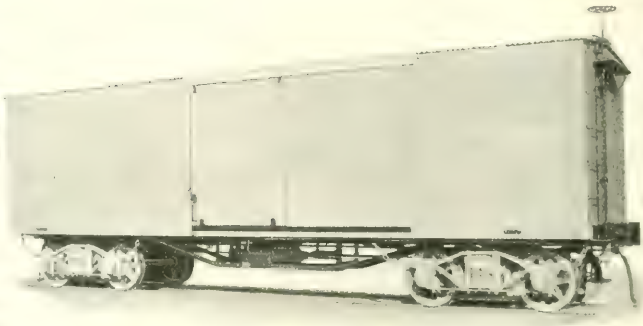

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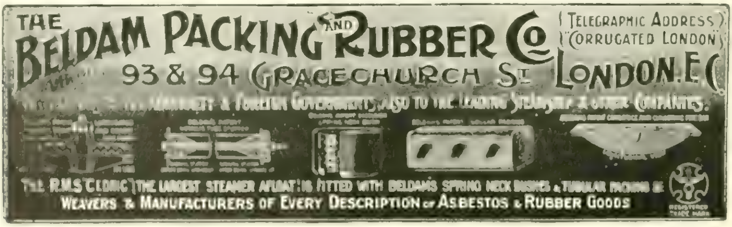

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PAGE'S WEEKLY

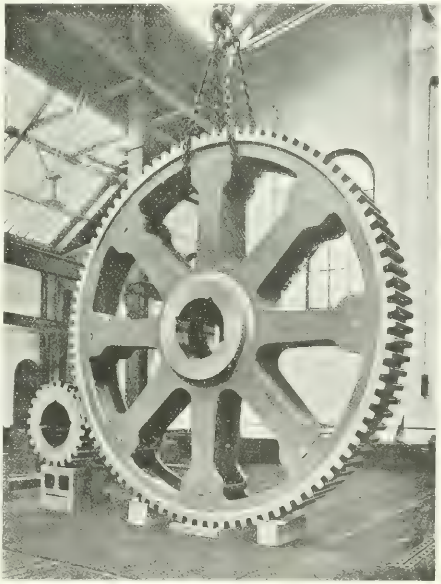
An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel and Shipbuilding Industries.

Vol. V. LONDON, FRIDAY, DECEMBER 30, 1904. No. 10.

The Offices of "Page's Weekly,"
Wednesday, Midnight.

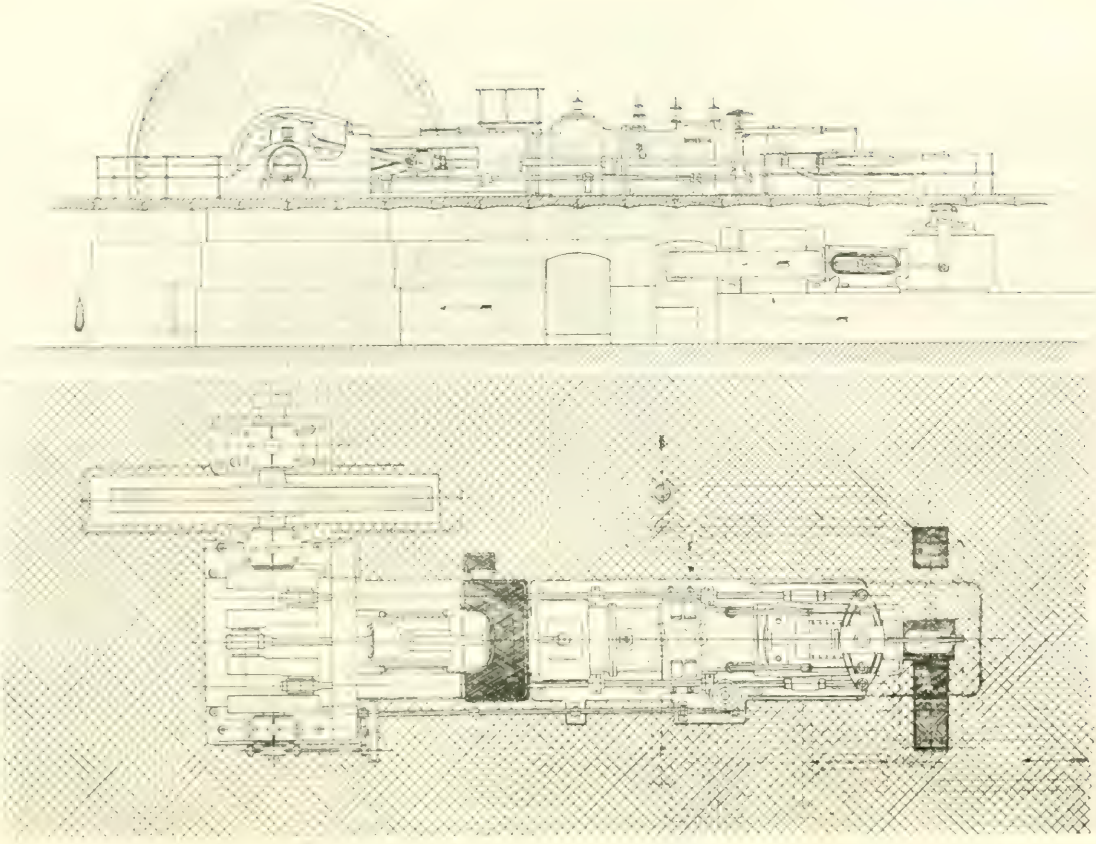
IN the instance I mentioned last week, an actual result was attained of the evaporation, from feed-water at 66·5 F, to steam at 161 lb. pressure above the atmosphere of 9·95 lb. water per pound of coal, thus utilising over 82 per cent. of the heat units resident in the sample of coal used. How many steam users are content year in and year out with a rate of evaporation of little more than half this?—where the fireman, with an energy which would be praiseworthy if applied, for instance, to the loading up of a cart, shovels in the coal more or less at random. The fireman, whether he knows it or not, is a manufacturing chemist on rather a large scale, and it rests entirely with himself whether he manufactures the article his employer wants or something very different, by a very slight modification in his methods.

In a recent analysis of a sample of engine coal the constituents were found to be approximately as follow:—carbon, 75 per cent.; hydrogen, 4·25 per cent.; nitrogen, 1·5 per cent.; oxygen, 10·75 per cent.; sulphur, 0·25 per cent.; incombustible matter, 8·25 per cent. The carbon, constituting three-fourths of the whole, is the principal agent in the production of heat, and it combines with the oxygen of the air supplied in one of two ways. Either it combines with twice its weight of oxygen and forms carbonic acid, or it unites with its own weight of oxygen and forms carbonic oxide.



SPUR WHEEL WITH CAST-IRON CENTRE AND STEEL RIM, AND FORGED PINION, BY MESSRS. SCOTT AND HODGSON, LTD.

The cast-steel spur rim, as illustrated last week, is in one piece, weighing 21 tons. The cast iron centre weighs 18 tons. Diameter of wheel 17 ft. 3½ in.



THE GAS ENGINE IN IRON AND STEEL WORKS.

Illustrative of Mr. J. H. Hamilton's recent paper on this subject (see abstract on page 7[illegible]), we reproduce by the courtesy of Messrs. William Beardmore and Co., Ltd., of Glasgow, plan and elevation of a [illegible]-h.p. Oechelhaeuser engine, which is used with blast furnace gas for driving a blowing cylinder. From the same firm we have received plans of a [illegible]-h.p. engine driven with producer gas, and employed for driving an air compressor. Oechelhaeuser engines for these purposes, and for electric traction and lighting, are now being built up to 2,[illegible] h.p.

Now we are coming to the point. For convenience, suppose that instead of dealing with three-quarters of a pound of carbon (*i.e.*, one pound of coal) we take the carbon itself as one pound. One pound of carbon, in burning to carbonic acid, liberates in round numbers 14,500 heat units ; the same pound of carbon, burning to carbonic oxide yields only 4,450 heat units. Hence coal, or carbon, may be burnt under two conditions, in one of which it is just three and a quarter times as valuable as in the other ; or, to put it in a form readily grasped, one pound of carbon, representing one and a third pounds of coal, may either be capable of evaporating the ideal quantity of fifteen pounds of water from and at 212 F., or it may only be capable of evaporating 4·6 pounds.

It rests largely with the stoker whether the furnace produce the beneficial CO_2 or the depraved CO., but, in avoiding Scylla, he may fall into Charybdis. If, in his anxiety to admit the full supply of oxygen to produce the desired effect, he is not careful, he may let in far too much, in which case he is lavishing his heat units in heating up large volumes of air, and thereby burning his furnace temperature to a point at which complete combustion cannot take place. Then his carbon goes up the chimney, heat-units and all, and advertises the fact of his unskillfulness to the surrounding neighbourhood by a banner of dense black smoke. All this is, of course, the merest commonplace—in a sense—but I have endeavoured to extricate the salient facts from the mathematical and chemical formulæ into which they are generally frozen, so that he who runs may read.

Now, a word on the other side. I can imagine a reader who is a user of steam-power going direct to the honest and hard-working individual who runs his carbonic-oxide manufactory, and, in common parlance, "blowing him up" for not admitting the right quantity of air to effect perfect combustion. No one, however, can tell, from the look of the fire, whether the percentage of CO_2 is high or low. The only way to do it is to make an analysis of the flue gases. The ideal, therefore, would be, to have a continuous analysis going on—an automatic chemist, in short. I believe such an apparatus exists. I know nothing about it, except that after perusing a pamphlet, in which the apparatus is described, I am convinced of its feasibility. If any reader is sufficiently interested to write for particulars, I shall have pleasure in referring him to the makers, who will doubtless do all that is necessary.

Meanwhile, I may be permitted to quote from their pamphlet a few lines descriptive of the conditions requisite in practice to effect perfect combustion. "About 1·3 times the theoretical quantity of air is required. If this proportion is exceeded, then the fuel required to heat the excess of air to the temperature of the furnace is wasted, and, whilst in practice the percentage of carbonic acid in flue gases under perfect conditions should be about 15 per cent.—the theoretical maximum of 21 per cent. cannot, of course, be attained—it will be very considerably below this figure, if a great volume of air is allowed to rush through the furnace.

How much coal is wasted, if the percentage of carbonic acid gas falls to a low level may be seen at a glance from the following table, which gives the loss of fuel as against the theoretically possible quantity for each per cent. of carbonic acid gas present in the flue gases.

CO_2 per cent.	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Loss per cent.	90	60	45	36	30	26	23	20	18	16	15	14	13	12

It has been found, in several instances, when analysing the gases of mechanically-fired furnaces, that the amount of CO_2 was as low as 8 per cent. when it might have been kept constantly at 13 per cent., and more. Considering that about 9 per cent. more coal is consumed if the percentage of CO_2 is 8 per cent. instead of 13 per cent., the waste will be equal to 900 tons a year, assuming that the total quantity consumed during the year is 10,000 tons. The apparatus is very simple, and I make no apology for thus mentioning an apparently practicable method of arresting this great, and often unsuspected, waste of force which is continually going on in our furnaces.

After the spell of fog that Londoners have been called upon *nolens volens* to endure, causing hours of wasted time in railway carriages, the subject of railway signalling during fog is one which will commend itself to engineers and laymen alike. Of the apparatus invented by Mr. Wynford Brierley, a Times correspondent states that it has been tried with satisfactory results on the Great Northern, and favourably considered by the railway authorities of several Continental Powers, while Lieut.-Col. Yorke, R.E., Chief Inspecting Officer of Railways to the Board of Trade, is able to express his belief that under many circumstances the apparatus may be a valuable auxiliary in railway working. The *modus operandi* of the device is explained by the correspondent as follows: a train is supposed to be proceeding from A to B in a dense fog, and there is a signal-box half-way between the two points, from which box it is assumed (merely to save needless detail of description) that a single semaphore signal-post is worked. The first part of Mr. Brierley's invention consists in placing alongside the metals, but clear of the wheels, a block of iron called the "rocker," connected with the wire that operates the semaphore in such fashion that when the signal "danger" is made on the semaphore the "rocker" is in one definite position, and when the signal "all right" is made, the "rocker" is in another position.

In other words, working the semaphore works the "rocker" also, and the signalman has no extra trouble or responsibility. This part of the apparatus is placed substantially nearer to the point A than the ordinary semaphore signal, so as to avoid the danger of over-running the signal. To the engine is affixed a trigger, which will impinge on the "rocker" when it is at "danger," or two triggers are affixed, one to catch "danger" and one to catch "all right," if that be desired. The triggers operate a mechanism which repeats in the cab of the engine the signal that is already made, but invisible, on the semaphore. Supposing this to be "danger," the train is stopped before it comes to the signal proper, or as soon as it would have been stopped if the air were clear, and nothing is easier after that than to arrange a code of signals, by whistle or electric bell, enabling the signalman to tell the engine-driver when to proceed.

The Correspondent mentions a well-known railway engineer, who, having seen the apparatus, and having made a practical trial of it, believes that Mr. Brierley's device excels all others in strength and indestructibility. This result is secured by an ingenious arrangement of double-coiled springs, with the coils in reversed order to each other, in the "rocker" and at the base of the trigger, so that each, after being displaced, returns automatically to its original position.

The springs on which the "rocker" works are far the stronger of the two; if they were not the "rocker" would not work the trigger; at the same time they are not so strong but that the "rocker" would yield to a rigid impact, such as that of a snow-plough or a hanging wagon door, and resume its position afterwards. On the other hand, the springs on which the trigger works yield easily to a touch of the finger.

The essential point is that the apparatus enables the signalman to transmit to the moving engine the same signal that is shown by the invisible semaphore, and that it produces this result with the least possible risk of failure.

NEWS ITEMS.

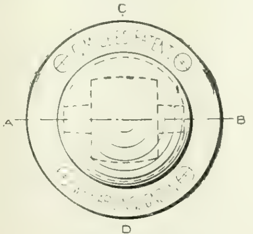
THE latest returns show that there are 21,462 Chinese already at work on the Rand, and 6,395 on their way. It is expected that from 6,000 to 8,000 will arrive per month during the first half of next year.

At a conference of miners' delegates at Dalkeith on Saturday, an alteration was announced in the rates for hewing coal at the Tranent collieries, thus reducing the wages of colliers by 6d. a day. The meeting agreed to ask for arbitration in the dispute, failing which is was resolved to bring all miners of the Tranent collieries on strike to try to effect a reasonable concession.

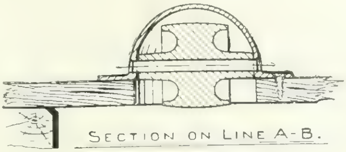
St. Catherine's Lighthouse, Isle of Wight, has just been provided with the most powerful flashlight in this country. It is of 15,000,000 candle power, and shows a white flash every five seconds. The lens is by Messrs. Chance Bros., of Birmingham, the whole of the revolving part floating in a trough of mercury. It is rotated by a large clock driven by lead weights, working in a solid drawn steel tube placed in the service-room below. Hitherto chain has been used in lighthouses for suspending the weights, but in this case a fine steel cable, about $\frac{1}{4}$ in. in diameter, has been adopted.

For the Drawing Office.

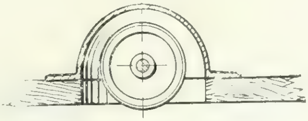
We have received from Mr. W. H. Harling, of 47, Finsbury Pavement, E.C., a useful roller attachment for tee squares. This (G. M. Lee's patent) consists of a small roller, in hemispherical outer casing, fixed close up to the stock of the square; the roller projects slightly below the under surface of the blade, and bears on the drawing board or on the paper placed thereon. The outer casing, while carrying the roller, also shields it from the hand. A circular hole, $\frac{13}{16}$ in. diameter, must be bored through the blade of the tee square to allow the roller to pass, and the casing is screwed on to the upper surface as shown in illustration.



— PLAN. —



SECTION ON LINE A-B.



SECTION ON LINE C-D.

The attachment has been devised in order to maintain the stock in better contact with the guiding edge of the drawing-board. It also reduces friction and conduces to the more cleanly condition of the drawing.

The late Sir Lowthian Bell.

The King has, through Lord Knollys, sent to the family of the late Sir Lowthian Bell the expression of his sincere sympathy in the great loss which they have suffered. His Majesty is pleased to say that he had a great respect for Sir Lowthian Bell, and always looked upon him as a very distinguished man.

In the course of an address on the 23rd inst, after the funeral, the Dean of Durham said Sir Lowthian might be described as the best scientific ironmaster in the world. He gave a lifelong denial to the statement than Englishmen can always "muddle through," for he based all his action and success on clearly ascertained knowledge.

The Pedrail.

A demonstration with the Pedrail tractor (1904 type) was held recently before the Liverpool Chamber of Commerce, Mr. Cox, vice-president, in the chair. A trial of this engine from Lincoln to London, 135 miles by road, took place last month under observation by representatives from the War Office and the Local Government Board, extending over a week. The trial is reported to have been most satisfactory, the train exciting considerable notice *en route*, especially when passing through the metropolis, *via* Finchley Road, Upper Baker Street, Marylebone Road, Regent Street, and Whitehall. The train consisted of the Pedrail tractor, a loaded wagon, and a War Office living van for the official observers. The total weight of the train, including the Pedrail tractor, was about 13 tons.

The marked features of the trial were :—(1) The total absence of any damage to the road surface throughout the trial, notwithstanding the heavy and wet condition of the roads during the first three days. (2) The absence of any appreciable wear on the rubber soles of the Pedrail feet, and the mechanism. (3) The same absence of vibration on the engine foot-plate (even when passing over cobble stone paving) that is obtained on a tram line.

The Panama Canal.

The field parties on the Panama isthmus are making such good progress that within a couple of months or less, we understand, it will be possible for the Commission to definitely adopt final plans for the construction of the canal. More or less vague reports have been published concerning radical changes in the plans, but the final decision upon such changes is delayed pending the gathering of more complete data. Engineers, contractors, and others who may be contemplating work at Panama, will be glad to know that the Sanitary Corps which has been operating there has already accomplished a great deal in the way of improving sanitary conditions and lessening the risk of disease. The anti-mosquito brigade has so thoroughly destroyed the breeding places of the mosquito in and about Colon, that the insects are said to be no more numerous there than in New York City during the summer.

It would appear, says the Engineering News, that conditions at Panama are to be such that any temperate man in good physical condition, who will avoid excesses, can go to Panama with no greater risk to life and health than would be involved in a trip to any of the cities in the United States bordering on the Gulf.

New Docks for San Francisco.

The state of California is to construct two immense concrete docks with steel frame work at San Francisco for the use of the Pacific Mail Steamship Company. The docks will be each 650 ft. long and 140 ft. wide and will cost approximately $400,000.

The Northern Engineering Co. (1900), Ltd.

The Northern Engineering Company (1900), Ltd., machine tool manufacturers, of Halifax, Yorkshire, have placed the control of their London and district, export and home sales departments in the hands of Mr. J. E. Lawler, of 39, Lime Street, Fenchurch Street, London, E.C., from January 1st.

Victoria Falls Power Scheme.

Taking the Falls as a centre, as shown on the opposite page, it is proposed to transmit electric current therefrom over a radius of 300 miles. The total amount of horse-power at present running to waste at the Falls is reckoned at thirty-five millions, and when the harnessing of the Falls is an accomplished fact, it may be taken for granted that the electrical radius of 300 miles will be considerably exceeded. The area which it is proposed to cover is probably more richly endowed with minerals than any equal area of the earth's surface. It is reckoned that the initial outlay will be at least half a million ; subsequent outlays will probably run into many millions.

Ferry Improvements.

The huge scheme of ferry improvement which the Tyne Commissioners are carrying out in Shields Harbour at a cost of £63,000 has been advanced another important stage. Some weeks ago a large ferry landing was placed in position at the New Quay, North Shields, and recently the old pontoon which had done duty at the market place, South Shields, was replaced by a landing-stage of even greater proportions. The work was carried out in a most expeditious manner under the personal direction of the engineer—Mr. James Walker. The new pontoon is 240 ft. long and 50 ft. wide.

A bridge, 125 ft. long by 23 ft. broad, is provided for vehicular traffic, separate roads being provided for vehicles leaving or approaching the ferries and a new bridge, 125 ft. by 18 ft. for the sole use of foot passengers, is also being placed in position.

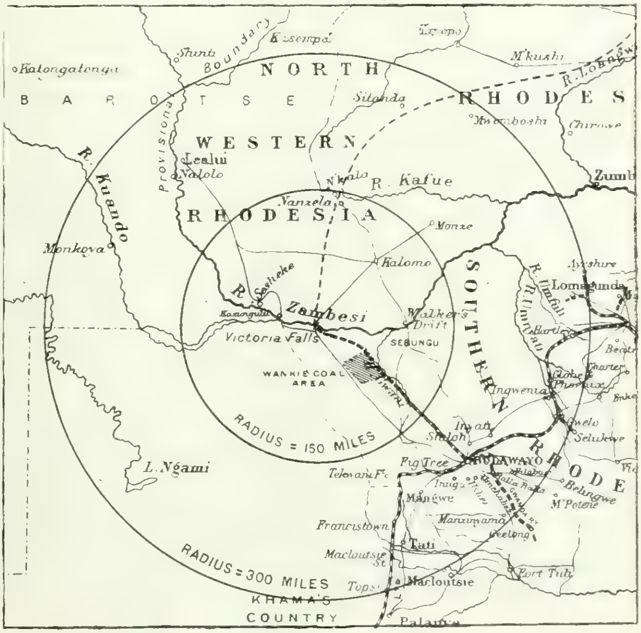
A scheme is on foot to provide cable and telegraphic communication between the United States, Siberia, and Japan, China, the Philippines, Korea, Manchuria, and also with the continent of Europe.

Tube Mills in South Africa.

Considerable importance attaches to the experiments carried out at the New Goch and Glen Deep mines with the tube mills or secondary crushers. At present, says a Times correspondent, the ore put through ranges from 3½ tons per stamp per day up to the 5·9 tons which the heavy stamps of the Crown Reef crush. In 1888, it may be mentioned, less than two tons per stamp was crushed, so the progress is evident, though small in comparison with what is to come, if the promised increase of 100 per cent. in the stamp "duty" (that is the amount put through the mills) be fulfilled with the tube or flint mills. The cost of installation is much less than would be entailed by additional stamps, while it is claimed that the extraction is augmented by about 5 per cent., or 2s. per ton of ore. From tests carried out in August last, Mr. Schumacher has stated that from ore of the value of 10·4 dwt. a ton, it is estimated that 95 per cent. of the gold contents can be extracted with the aid of tube mills, as against 90 per cent. without. This is as near perfection in the matter of extraction as it may be possible to get, and it opens up encouraging prospects for almost the lowest grade propositions. The tube mills are new to the Rand, and were first installed at the New Goch by the General Mining and Finance Corporation, while Messrs. Eckstein's consulting metallurgist has made exhaustive experiments with them at the Glen Deep. The best testimony to their expected utility is to be found in the fact that a large number of them have been ordered for immediate use at many of the principal mines. An illustrated article on tube mills will be found in a recent issue of Page's Weekly.

An Indian Power Plant.

The opening of the power station near Kartairy, in connection with the cordite factory in the Nilgiris, says Indian Engineering, cannot fail to give a pause to those who imagine that American firms alone can undertake installations for the electrical transmission of power. In his opening remarks Major Babington, superintendent of the factory, explained that when he went home to have plans prepared for the work he was informed that he would have to go to America to get what was wanted. However, he did not believe this and his unbelief was justified, for the works are equipped by two English firms—Messrs. Gunther, of Oldham, and the General Electric Company, of London. The latter firm bears no relationship to the great American combine of the same name, to which the work would no doubt have been entrusted had a certain well-advertised "clever young Engineer officer" been consulted.



From the African World.

TRANSMISSION OF ELECTRICAL ENERGY IN RHODESIA: THE 300-MILE RADIUS FROM THE VICTORIA FALLS, OVER WHICH IT IS PROPOSED TO DISTRIBUTE CURRENT.

No. 7 Lever Shear.

[illegible] completed by the United Engineering and Foundry Company, of Pittsburg, Pa., and is said to be the most powerful yet built in America. The details of construction are as follow :—

Capacity, 6½ by 6½ in. cold soft steel and miscellaneous extra heavy scrap.

Knives, 24 in. long, with four cutting edges.

[illegible]

Weight with 125 h.p. electric motor, 180,000 lb.

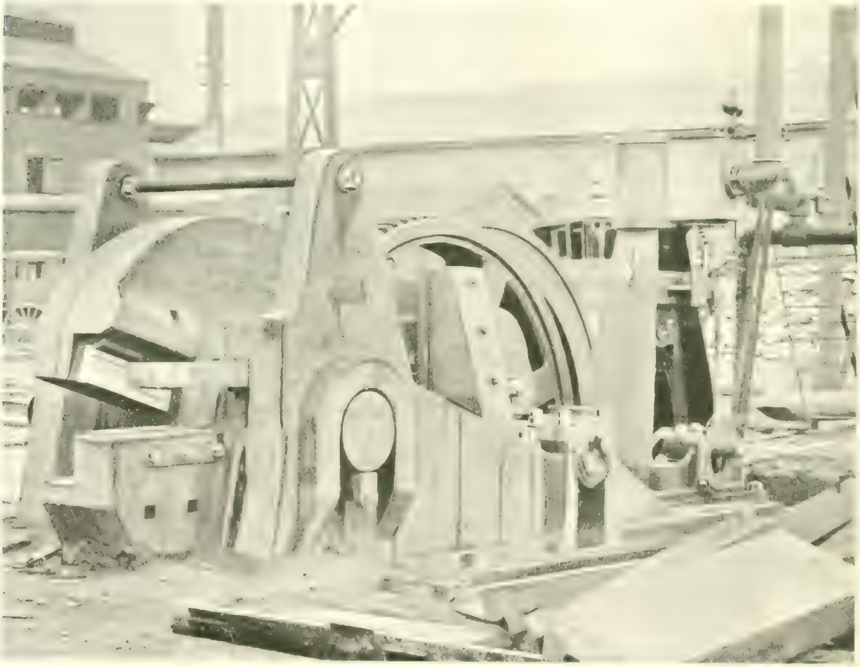
Floor space, 10 ft. 3 in. by 23 ft.

Speed, 16 cuts per minute when flywheel runs 120 revolutions per minute.

This shear can be driven by belt, but either engine or motor drive is recommended for it.

The Last of the St. Louis Exhibition.

The attendance at the St. Louis Exhibition was approximately 19,000,000. The largest attendance was on St. Louis day, September 15th, when 404,500 admissions were recorded at the gates. According to arrangements, the evacuation of the exhibit buildings and the wrecking of the structures is being carried out as promptly as possible. As soon as the lights were turned out gangs of men began to uncover the switching tracks leading into the buildings, which have been buried up in the streets and walks since the opening of the exhibition. It is likely that the exhibits will nearly all vanish within a few weeks at most, and in a few months the many hundreds of buildings now standing upon the grounds will be visible only in photographic records, or in architects' drawings.



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ARTILLERY REARMAMENT.

After a delay extending over three years, orders have been given out, or will be given out immediately, for the complete rearmament of the artillery. The work will be undertaken by the Ordnance factories, and by the three civil firms on the War Office list, Elswick, Vickers, Sons and Maxim, and Cammell and Company. It is something to be able to record, even after this long delay, that the lessons of the South African war have not been entirely forgotten. That war brought home to the authorities the fact that our Horse and Field Artillery armament has been for a long period completely out of date.

While other nations were equipping their artillery with quick-firing guns, employing not only case ammunition containing its own means of ignition, but also hydraulic buffers or a system of springs calculated to absorb completely the recoil of the firing, our authorities were content with the separate loading of projectile and ammunition and with a recoiling gun.

It is true that the spade device of Sir George Clarke was an improvement, but even its adaptation to our ancient system of armament could not modernise weapons hopelessly antiquated in pattern.

At last, in 1901, it was decided to take official cognisance of these things, and a committee, with Major-General Sir George Marshall as President, took the matter in hand. The Committee, let it be said at once, did its work thoroughly and well. They decided that the Field Artillery gun should not only be modern, but should throw a more powerful projectile, and accordingly, certain firms were asked to manufacture sample guns and carriages. The Ordnance factory at Woolwich, the Elswick firm, and Messrs. Vickers, Sons and Maxim accordingly entered into what virtually was a friendly combination to produce the best weapon.

The result was a not unnatural compromise, a second specification being drawn up embodying what were considered the best points in all the guns and equipments submitted, and these new guns underwent a further exhaustive trial. For this trial it was also decided to have a larger number of guns and carriages manufactured; and two batteries of Horse Artillery and two of Field Artillery were ordered from Elswick and from Messrs. Vickers, Sons and Maxim, one battery of each kind from each firm. The batteries quite fulfilled the expectations of the Committee, alike as regards accuracy, range, and rate of fire. A rate of fire of 20 rounds per minute was obtained from each type of gun, and the effective shrapnel range was only limited by the length of fuse, which with the fuses supplied gave good results at 7,000 yards. As the result of these trials, the Committee were able in March, 1904, definitely to recommend the new model 18½-pounder quick-firing gun for the Field Artillery, and the new 12½-pounder quick-firing gun for the Horse Artillery.

It seems almost incredible, but it is true, that although the total cost of rearming ninety batteries of Field Artillery and seventeen batteries of Horse Artillery is estimated at only £2,500,000, the Treasury refused to find the money for the manufacture of guns for the Home Army, and allowed the whole thing to be hung up for an indefinite period. Fortunately, it was decided that the Indian Artillery should be rearmed pending the decision of where the money for dealing with the Home Army was to come from. Three batteries of Horse and eighteen of Field Artillery were accordingly ordered for India. It is hoped that these guns may be ready this year. The further needs of India will be met by manufacture in that country.

With regard to the Home Army, if it is true that the departmental difficulties have been overcome and that the orders have been issued, the rearmanent of the home artillery may be completed in two years. Until that time, in spite of the resources of this country, engineering and financial, our artillery will have to make the best of weapons which Continental armies have already relegated to the museum.

NAVAL NOTES.

WEEKLY NOTES OF NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

[illegible] NAVAL CORRESPONDENT.

I[illegible]

The present issue being the last for 1904, it may be as well to add to that previous summary, notes on the completions of the vessels [illegible] following further launches since the beginning of [illegible]

GREAT BRITAIN.—*Britannia*, battleship, at Portsmouth, on December 10th.

GERMANY.—*Deutschland*, battleship at Kiel, on November 19th.

[illegible] Fore River, on November 10th. *Tennessee*, armoured cruiser, at Philadelphia, on December 3rd.

The completion of vessels other than torpedo craft for the seven principal Powers during 1904, number forty. They are divided as follows:

GREAT BRITAIN.

Five completed and commissioned for the British navy, and three more completed ready for commissioning during the year. These are the *Cornwallis*, commissioned at Chatham, on February 9th; *Queen*, [illegible] *of Wales*, at Chatham on May 18th; the *Swiftsure* [illegible] which are to enter into service in the early part of the new year. Six new armoured cruisers have entered into service, the *Euryalus*, commissioned on January 5th, at Devonport; the *Essex*, commissioned on March 22nd, at Devonport; the *Lancaster*, commis[illegible] on May 21st, at Devonport, and the *Cornwall* and [illegible] at Devonport and Portsmouth respectively.

In the protected cruiser class, the *Topaze* has been [illegible] December 6th, while the *Amethyst*, *Diamond* and *Sapphire*, are all completed and ready to hoist the [illegible]

FRANCE.

No battleships have been completed during the year for France, but four armoured cruisers, the *Condé*, *Gloire*, *Dupetit Thouars*, and *Léon Gambetta*, have been completed. All with the exception of the last-named have been commissioned. Five destroyers and about eighteen submarines have also been added to the effective list.

GERMANY.

Two battleships have been completed, the *Braunschweig* and *Elzass*, and have joined the active squadron. Three protected cruisers also, the *Hamburg*, *Bremen*, and *Berlin*, have been completed and passed into service. Six torpedo-boat destroyers have also been delivered from the contractors.

RUSSIA.

The preparation of the Second Pacific Squadron for service led to the hasty completion of three new battleships, the *Kniaz Suvaroff*, *Orel*, and *Borodino*, which have accompanied the fleet on its journey to the Far East. There have also been three protected cruisers completed and commissioned during the year, the *Oleg*, *Jemtchug*, and *Izumrud*.

ITALY.

The *Benedetto Brin*, which has been several times before reported as completed, entered into active service in the spring of 1904. No armoured cruisers have been completed, and only two destroyers have been completed, both by Pattison of Naples.

UNITED STATES.

[illegible] during the past year have been devoted mainly to launches, and there have been but few completions. The only new battleship put into commission was the *Ohio*, which was completed during the autumn. Five small cruisers, the *Denver*, *Des Moines*, *Tacoma*, *Chattanooga*, and *Galveston*, have also been delivered and commissioned, and about four destroyers have satisfactorily completed their trials and entered into service.

THE UNDERTYPE ENGINE.

BY J. C. R. ADAMS.

(Continued from page [illegible].)

Previous articles by the same author on the subject of Portable Engines will be found in the July, August, September, and October numbers of PAGE'S MAGAZINE, and in the subsequent numbers of PAGE'S WEEKLY.

IN the Robey Compound Undertype engine the bedplate is of cast-iron, forming, a very massive and rigid base, in one piece from end to end. As can well be imagined, the weight of this unit in large sizes is more than can be easily handled for export purposes. To meet such cases, a wrought-iron bedplate has been designed as an alternative, and the engines can be built either way, at the option of the purchaser. The link expansion gear already illustrated is used on the high-pressure cylinder, and an independent cut-off valve is applied to the low-pressure cylinder worked by a separate eccentric, so that the rate of expansion can be varied as desired.

The cranks are balanced by counterweights, and a central bearing is provided. Messrs. Robey favour the four guide bars, as used universally for locomotive engines, in place of the newer fashion of circular guides.

ROBEY COMPOUND UNDERTYPE ENGINES (FIG. 4).

Horse Power.		Cylinders.			Revs.	[illegible]
Nom.	Effective.	H.p.	L.p.	Stroke.	Per min.	[illegible]
8	[illegible]	[illegible]	[illegible]	12	[illegible]	[illegible]
10	24–32	6	[illegible]	14	172	[illegible]
12	29–38	[illegible]	[illegible]	14	[illegible]	[illegible]
14	34–45	7¼	[illegible]	16	[illegible]	[illegible]
16	[illegible]	[illegible]	13	[illegible]	[illegible]	[illegible]
20	48–64	[illegible]	[illegible]	16	[illegible]	220
25	60–80	[illegible]	[illegible]	18	[illegible]	280
30	72–96	[illegible]	18	18	[illegible]	[illegible]
35	[illegible]	11¼	[illegible]	[illegible]	[illegible]	400
40	96–128	12	[illegible]	24	[illegible]	490
50	[illegible]	13¼	23	24	[illegible]	760

The steam chests are outside the cylinders, readily accessible, and the starting valve is of commendable simplicity and conveniently placed.

Altogether this engine, on examination, appears well fitted to sustain the great reputation of its makers.

The working pressure is 150 lb., and the cylinder ratio 3 to 1.

A central bearing with vertical adjustment only is fixed between the crank webs, the two main bearings on the frame being made in four

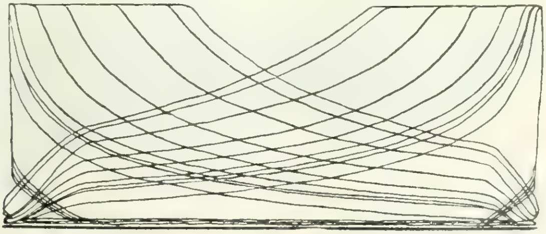


FIG. 3. DIAGRAM SHOWING THE VARYING POINTS OF CUT-OFF OBTAINABLE WITH THE ROBEY AUTOMATIC EXPANSION GEAR.

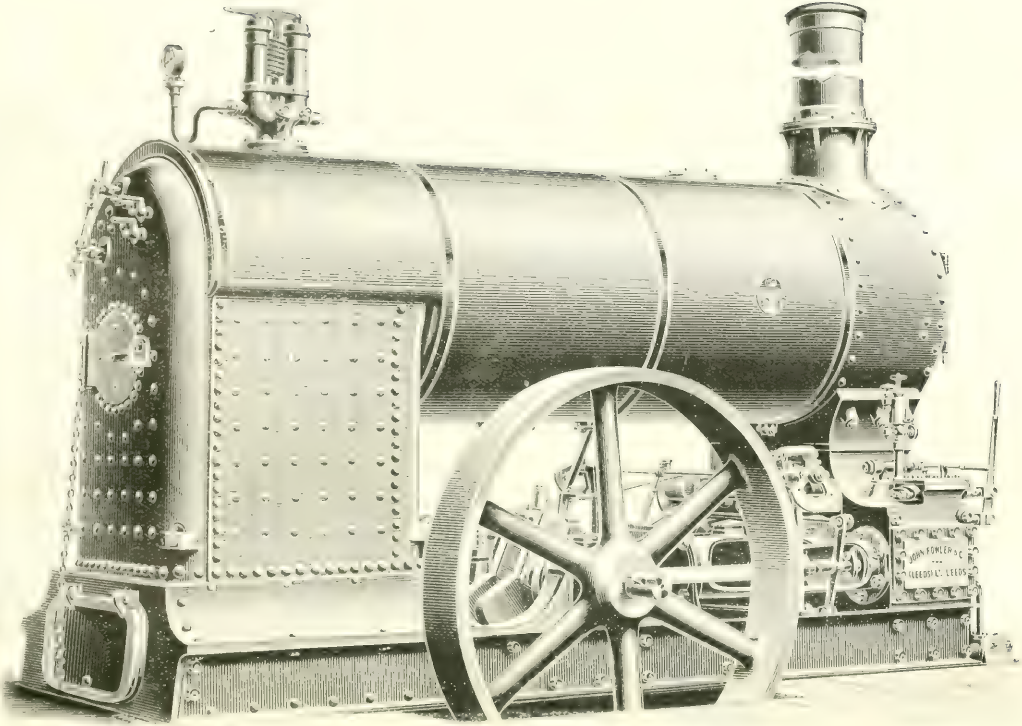

JOHN FOWLER & Co (LEEDS) Lᵀᴰ LEEDS

FIG. [illegible]—MESSRS. [illegible] FOWLER'S COMPOUND SEMI-FIXED ENGINE.

parts, adjustable both vertically and horizontally.

To facilitate starting, an automatic arrangement admits steam direct from the boiler to the low-pressure cylinder, closing again as soon as the engine is in motion.

Messrs. Fowler's catalogued dimensions for engines (as fig. 5) with wrought or cast-iron beds, is as follows, the working pressures being, for compounds 120 lb. to 150 lb., and for the two-cylinder automatic high-pressure class, 140 lb. per square inch:—

COMPOUND.					HIGH PRESSURE.		
Nom. H.p.	Cylinders. H.p.	L.p.	Stroke.	Revs. Per min.	Indicated h.p. at 140 lb.	Best working h.p.	Revs. per min.
8	5¾	9	12	180	40	28	180
[illegible]	6⅝	10	14	155	50	35	155
12	7½	11½	14	155	60	42	155
[illegible]	8	12½	15	145	80	56	145
20	9	14	16	135	100	70	135
25	10	[illegible]	18	120	125	88	120
[illegible]	11	17	18	120	150	105	120
40	12	21	24	100	200	140	[illegible]
50	13	23	24	100	250	175	90
75	17	27	27	[illegible]			
[illegible]	18	29	30	90			

The cylinder ratios vary somewhat in the different sizes, but average from 2½ to 2¾ to 1.

Messrs. John Fowler and Co., Ltd., Leeds, were the first to apply the compound system to undertype engines. In the year 1878 this firm produced their "Yorkshire" engine, a non-condensing compound, and it at once became evident that the right note had been struck.

Other leading makers of semi-portable engines quickly followed, and it is now possible to procure compound undertype engines of first-class design and construction from a number of different sources.

Fig. 5 represents Messrs. Fowler's design with wrought-iron frame, balanced cranks, tubular guides, and Hartnell's automatic expansion gear. The same engraving also represents their double cylinder automatic expansion engine, these engines being identical in build with the compound except in the arrangment of cylinders. In engines of 20 n.h.p., and upwards, an outside bearing is provided for the crank-shaft.

(*To be continued.*)

REAR-ADMIRAL MELVILLE ON NAVAL RESERVES.

Rear-Admiral G. W. Melville predicted some time ago that the reserve battalions of the contesting foes in the Far East will really decide the contest, and in the same way he is of opinion that it is the reserve of wealth, resources, and manufactures, as well as a great body of men capable of being trained to naval duties, that will constitute the actual naval strength of the United States.

The admiral is emphatically of opinion that an effective naval reserve of trained men must possess engineering inclinations and mechanical ability. In the operation of the various mechanical appliances that are now installed on board the warship, it is a technical rather than the nautical training that must be secured. The three great manufacturing nations—England, Germany, and the United States—thus possess an inestimable military advantage in their ability to secure in time of war the reserve of men needful for naval purposes.

The experience of the war with Spain conclusively showed that skilled mechanics, with excellent powers of observation, do not require a long period to be trained for efficient duty, either in the turret or in the engine-room. The capability of the artisans of different nations to adapt themselves to technical naval duties may thus be the real test of strength of sea power.

The co-operation of the engineer by no means ends with the mechanical training of the rank and file. In a few pointed sentences Admiral Melville shows how dependent the naval authorities are upon the managing engineer.

There are engineers, he says, in Europe, as well as in America, who are controlling and directing more employees than are comprised in the entire personnel of the United States Navy. An engineering mind is an analysing, directing, and military mind, and it can be employed for the accomplishment of strategical and tactical movements. The rapidity with which an army corps can be moved may decide the destiny of a nation; and the success of this work, under existing conditions, is more likely to be dependent upon the superintendent of a railroad than upon a military commander. The executive ability of the managing engineers of great industrial plants in expeditiously furnishing munitions of war, may be of greater benefit than the enrolment of an army corps.

QUESTIONS OF THE DAY.

III. The National Encouragement of the British Inventor: How can it be secured ? [illegible]

THE following extracts are from Sir Hiram Maxim's contribution to the discussion on Mr. Thwaite's paper read before the Society of Engineers in March, 1902. As to the continuous taxation of the British inventor, Sir Hiram remarked :—

"It was a great hardship to the struggling inventor to be forced to pay a standing tax." He compared the taxation with that levied on the owner of a newspaper, the registration of which involved only one payment.

As to the life of a patent, Sir Hiram Maxim considered that it should be at least 17 years.

In many military and naval inventions, it took nearly 14 years to get them understood and introduced into an unwilling service. In his opinion, this class of patent should not only be very cheap, but should also have an exceptionally long life.

On the question of the character of the tribunal or testing the validity of patents—or patent disputes—Sir Hiram Maxim said :—

"Why should they not have a committee of experts, recognised by the Government, who would be able to decide patent cases in a few hours ?

Sir Hiram Maxim's experience in our British system of testing patents before non-technical judges, with merely legal training, is amusing and full of interest. It amply confirms the views held by the majority of those who have been compelled to defend their patent rights.

He remembered one case in which he was told that the judge did not go by the quality of the evidence at all, because he did not understand the subject, but he looked rather at the volume of the evidence. The solicitor admitted that he (Sir Hiram) had an extremely good case, and that the facts were all in his favour ; and he (Sir Hiram) naturally supposed, as those had been very clearly set forth by a few competent witnesses, and as there were plenty of documents to show the truth of their contention, that that would be all that was necessary. However, the other side had put in an immense volume of testimony, of an extremely weak nature, much of it not bearing on the case at all, but the lawyer said that the judge would go [illegible] by its character. So other witnesses were employed, and he (Sir Hiram) suggested that if it waere true that the judge did not understand the question at all, and if it were quite impossible to make him understand it, the evidence should be put on the scales and weighed, without being read at all, and as far as he (Sir Hiram) was concerned, his case should be largely written on one side of very thick paper. The scales of justice being completely impartial, he would then be sure to win his case.

He did not remember ever having been in a patent suit in which it was not impressed upon him by his legal advisers that the very first thing they had to do was to educate the judge ; and in many cases he had heard most eminent counsel, in opening a case, speak for many consecutive hours in delivering a speech, which, in reality, was nothing more nor less than a primary lecture on science and mechanics—a lecture delivered for the purpose of giving to the judge just sufficient knowledge of the subject to enable him to understand the evidence.

Sir Hiram Maxim fully endorsed the greater part of Mr. Thwaite's views on the subject which have been reproduced in these columns.

In discussing Mr. Thwaite's paper, Mr. F. C. Shirley-Price made use of the following argument in favour of reducing the cost of British patents :—

He was thoroughly in sympathy with Mr. Thwaite, as to the penalising effect of the British patent laws upon the poor man.

He believed that the majority of our inventions were the result of the observations of working men. But if a workman made his invention known to his employer, in most cases he feared he would get few thanks for it.

Therefore the man kept the knowledge to himself, until he had got a little money, and until he could take out a provisional specification.

Perhaps when the second payment became due the man would be without money and his invention would be lost.

He hoped that the new patent law would reduce the taxes to the level of those of an American patent.

LAUNCHES AND TRIAL TRIPS.

H.M. BATTLESHIP "HINDUSTAN."

This first-class battleship has just completed her official trials. The *Hindustan*, the third of the modern British battleships built by Mesrs. John Brown and Co., at Clydebank, is of the *King Edward VII.* class, with a total length of 425 ft., and a beam and draught of 78 ft. and 26 ft. 9 in. respectively. Her displacement is 16,350 tons, and her engines, also constructed by the builders of the vessel, are designed to indicate 18,000 h.p., giving a speed of 18·5 knots. She is fitted with eighteen boilers of the Babcock and Wilcox type, and three of the cylindrical type.

NEW TURBINE STEAMER.

There was launched a few days ago, from the yard of Messrs. Alexander Stephen and Sons, Ltd., Glasgow, the ocean turbine steamer *Virginian*, for the Allan line. This steamer, and the sister ship *Victorian*, have been built for the Canadian mail and passenger service of the Allan line. The *Virginian* is 540 ft. long, 50 ft. broad, and 40½ ft. in depth. She will have three propellers worked by one high-pressure and two low-pressure Parsons' turbine engines, which will revolve at very high speed—from 270 to 300 revolutions per minute. The central propeller, arranged as in a single-screw vessel, is worked by the high-pressure turbine, while the other two propellers are arranged as in a twin-screw steamer, with a reversing arrangement which will enable them to be driven full speed astern either together or independently. The *Virginian* is constructed to carry 1,500 passengers, and is fitted with Marconi apparatus.

BELFAST.

The steel-screw steamer *Telamon*, built by Messrs. Workman, Clark and Co., Ltd., has been undergoing her trials in Belfast Lough. This vessel is the fifteenth built by the above firm for the same owners, Messrs. Alfred Holt and Co., of Liverpool, and is 383 ft. long with a gross tonnage of 4,500 tons. In designing the *Telamon*, special consideration has been given to the requirements of the Australian trade.

The engines and boilers, constructed by Messrs. Workman, Clark and Co., at their Queen's Road Works, consist of a set of inverted direct acting triple expansion engines, with the necessary auxiliaries supplied with steam from two large steel cylindrical multitubular boilers working under the owners, closed ash pit system of forced draught.

COAST GUARD CRUISER.

Messrs. Workman, Clark and Co., Belfast, have also just launched from their South yard a steel screw steamer which they have built to the order of the British Admiralty. The new vessel has been named *Squirrel*, and will be employed as a Coast Guard cruiser in the English Channel. The engines and boilers have been constructed by the builders at their Queen's Road Works, and consist of a set of triple-expansion engines supplied with steam from multitubular boilers working at a pressure of 155 lb. per square inch.

THE TYNE.

On Friday afternoon last, there was launched from the yard of the Northumberland Shipbuilding Company, Ltd., Howdon-on-Tyne, the screw-steamer *Hillhouse*, built to the order of Messrs. John Cory and Sons, Ltd., Cardiff, for the Seville and United Kingdom Carrying Company, Ltd.

This vessel is the tenth built for the above firm and is constructed to the highest class at Lloyd's, single deck, built under special survey. Her dimensions are 335 ft. overall, 48 ft. breadth extreme, and 24 ft. 3 in. moulded. The machinery will be supplied by Messrs. Richardsons, Westgarth and Co., Ltd., Sunderland, with cylinders 23½ in., 39 in. and 64 in. by 42 in. stroke, and two large boilers 15 ft. diameter by 10 ft. 6 in. long, with a working pressure of 160 lb. per square inch. The vessel is designed to carry 5,200 tons on a light draft.

THE TEES.

Messrs. Ropner and Son, Stockton-on-Tees, have just launched from their yard a new steel-screw steamer. The principal dimensions are: Length, 325 ft. 3 in., breadth, 46 ft. 6 in., depth, 23 ft. The vessel will be classed 100 A1 at Lloyd's, and is built on the two-deck rule, having one deck laid with poop, bridge and forecastle. The poop will be fitted up for accommodation of captain and officers, whilst the engineers' accommodation will be arranged in houses on the bridge deck, the crew being berthed in the forecastle.

The engines, which are of the triple-expansion type, by Messrs. Blair and Co., Ltd., of Stockton-on-Tees, are of about 1,250 i.h.p., having two steel boilers 15 ft. diameter by 10 ft. long, working at 160 lb. steam pressure. The vessel has been built to the order of Messrs. Henry Scholefield and Son, Newcastle-on-Tyne, under the superintendence of Mr. Baxter and Captain J. Temple, both of Newcastle.

HEAT TREATMENT EXPERIMENTS WITH CHROME-VANADIUM STEEL.

By Captain H. Riall Sankey, and Mr. J. Kent Smith.

W[illegible] of a sample of steel containing small percentages of chromium and vanadium. The cost of "medicine" of such steel is also comparatively low, and experiments were, therefore, undertaken with the object of making this special steel on the open hearth. Unfortunately, the works at Queen's Ferry, where the experiments were being made, were closed down in regard to the manufacture of steel, and the progress towards making this special steel for commercial purposes has been retarded.

The following table shows the chemical analysis of Chrome-Vanadium steel, and the principal tests were carried out with cast 349, analysis No. 2.

[illegible]	1	2	3	4	5	6	7	8
								Cruci-[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	Per [illegible]	Per [illegible]	[illegible]	[illegible]
Carbon	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	0·065	[illegible]	[illegible]	0·019	0·173
[illegible]	[illegible]	0·394	0·369	0·491	0·356	0·472	0·245	0·837
[illegible]	[illegible]	[illegible]	[illegible]	1·070	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0·169	0·160	[illegible]	0·161	0·187	[illegible]	[illegible]

The scheme of heat treatment was practically the same as that followed by the Alloys Research Committee [illegible] F.) alone is additional, and was carried out because it had been stated that quenching in oil at this temperature gave very good results; and the heat treatment at 690 deg. C. (1,274 deg. F.) corresponds to the 720 deg. C. (1,328 deg. F.) treatment of the Alloys Research Committee, the lower temperature being selected because cooling curves of this special steel showed that the Ar_1 point was between 710 deg. and 715 deg. C. (1,310 deg. F.). The quenching was done in a good bulk of water at 20 deg. to 25 deg. C., or in lard oil, and the sample well moved to ensure equal contact. For reheating the sample was introduced with the muffle slightly under the desired temperature; the temperature was then raised, and held at the desired point for ten minutes. For the annealing tests the samples were introduced into a muffle at about 500 deg. C. (932 deg. F.), which was then gradually raised to the desired point, and held for half-an-hour at that temperature; the samples were then withdrawn and cooled in warm ashes.

In the soaking tests, the temperature of the samples was raised with that of the furnace to the desired temperature, whic hwas then maintained at that point for 12 hours, and the samples were left in the muffle to cool.

The majority of the photo-micrographs were made at a magnification of 350, but have been slightly reduced for reproduction in PAGE'S WEEKLY, and the sections were prepared from separate pieces of metal treated simultaneously—in the centre of the muffle with the tensile pieces.

The muffle was of the electric resistance type, with current at 100 volts pressure, 27 amperes being required to keep the muffle at 1,200 deg. C.

The principal temperature observations were made by means of an electric resistance thermometer, connected to a Callender and Griffith's recorder, while, as a check, indications were continuously taken with a thermo-couple and multivolt meter.,

The authors are of opinion that the best recalescence results can be obtained by the use of a very carefully standardised couple, the maintenance of an efficient vacuum in the furnace chamber, a delicate galvanometer, and a chronograph recorder. The average recalescence point of three closely agreeing cooling curves of cast 349, taken in this way, practically agrees with that determined by the differential method at the National Physical Laboratory.

Effect of Annealing Cr Va Steel.

[illegible]

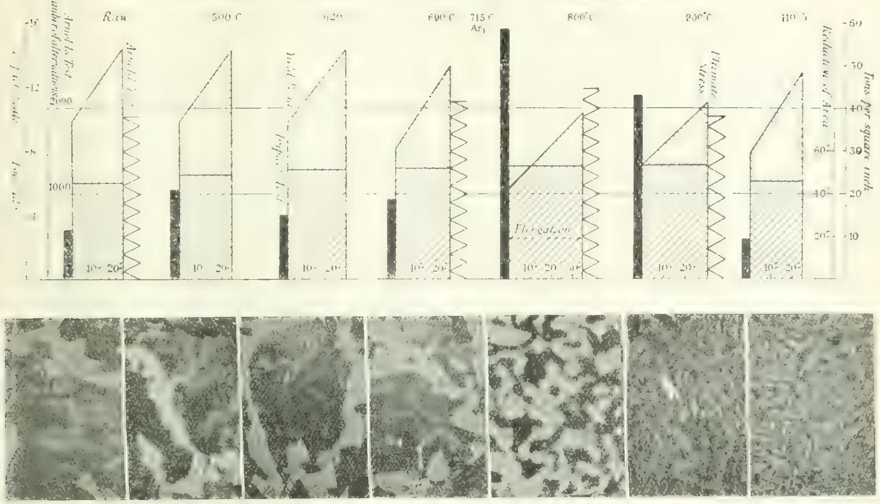


FIG. 1.

Effect of Soaking Cr Va Steel.

Tensile Impact and Arnold's Test plotted from Table I. Photomicrographs × 200 diams.

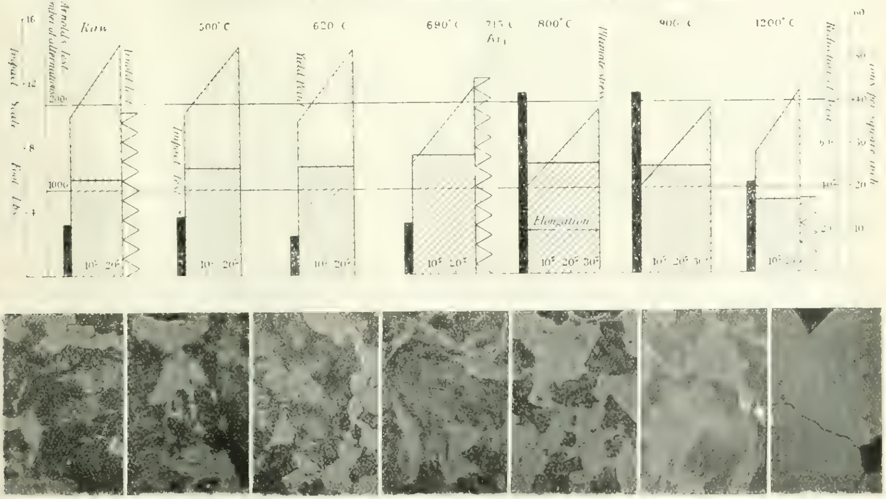
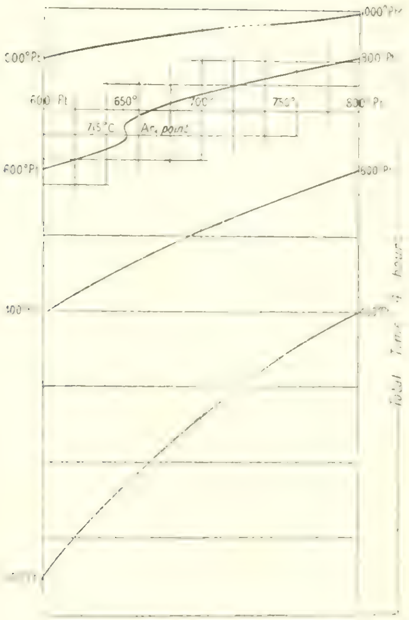


FIG. 2.



[illegible]

[illegible] recorder. The tensile pieces were only 9 in. all over throughout, and the elongation was measured on 2 in. All precautions were taken to ensure accuracy.

The "notched" impact tests were made on the impact testing machine, which will be familiar to readers, the test pieces being ⅜ in. broad, the depth of notch such that 0·137 in. of metal remained, and the specimen was broken with one blow. Professor Arnold made the alternations-of-stress tests on pieces [illegible] the results must be taken as comparative only.

The results of the mechanical tests are mostly shown plotted in figures 1 to 6, but the hand-bending tests are shown in a separate table.

Probably the most noticeable deduction to be de- [illegible] marked change that takes place between the tem- [illegible] and 1,472 deg. F.). The change no doubt takes place at [illegible] and the alteration taking place in the photo-micrograph section, as well as in the mechanical tests can be seen at a glance. In the annealing and soaking trials, figs. 1 and 2, the result of the change is to reduce the yield point and the ultimate stress materially, but to increase greatly the impact figure, while the elongation and reduction of area are also somewhat increased.

The water-quenching trial (fig. 3) shows that quenching at 690 deg. C. has little effect on the steel, as compared with the raw steel or that annealed at 620 deg. C., but when quenched at 800 deg. C. the steel is quite ruined. The great difference in the hand-bending tests when water-quenched at 690 deg. C. and 800 deg. C., shown in the table, should also be noted.

In the case of the oil quenching trials (fig. 4), the tensile figures are not materially changed between these temperatures, but the impact figure and number of alternations in Professor Arnold's test are much reduced.

The hand-bending test also shows a material difference; when oil quenched at 690 deg. C., the sum of

Ref. No. in Table 1	[illegible] of steel	[illegible]	No. of r[illegible]			[illegible]
			[illegible]	[illegible]	Sum.	
1	[illegible]	[illegible]	[illegible]	[illegible]	11	[illegible]
[illegible]		[illegible]	8	[illegible]	1[illegible]	[illegible] showed crack at 7th bend backward
[illegible]		[illegible]	9	[illegible]	18	[illegible]
11		[illegible]	9	[illegible]	1[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	1[illegible]	[illegible]
1[illegible]		[illegible]	9	9	18	Fairly easy to bend.
[illegible]		[illegible]	—			Too stiff to bend
[illegible]		[illegible]				[illegible]
[illegible]		[illegible]	4	[illegible]	[illegible]	Very stiff to bend
[illegible]		[illegible]	[illegible]	[illegible]	18	Fairly stiff to bend, [illegible]
24		Oil quenched 900°, reheated [illegible]	[illegible]	[illegible]	10	Very stiff to bend.
[illegible]		[illegible]	4	3	7	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	1[illegible]	[illegible]
4[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12	[illegible]
[illegible]	[illegible]	Raw	8	7	15	Stiff to bend
* [illegible] Steels	Bad	Unknown	1[illegible]	1	2[illegible]	Very easy to bend
	Good		4	4	8	Easy to bend.
	Good		4	[illegible]	7½	[illegible] to bend
	Good			[illegible]	5½	[illegible] to bend
	[illegible] of good quality		2½	2	4½	Very easy to bend

* Not [illegible] for Arnold's test.

HAND-BENDING TESTS.

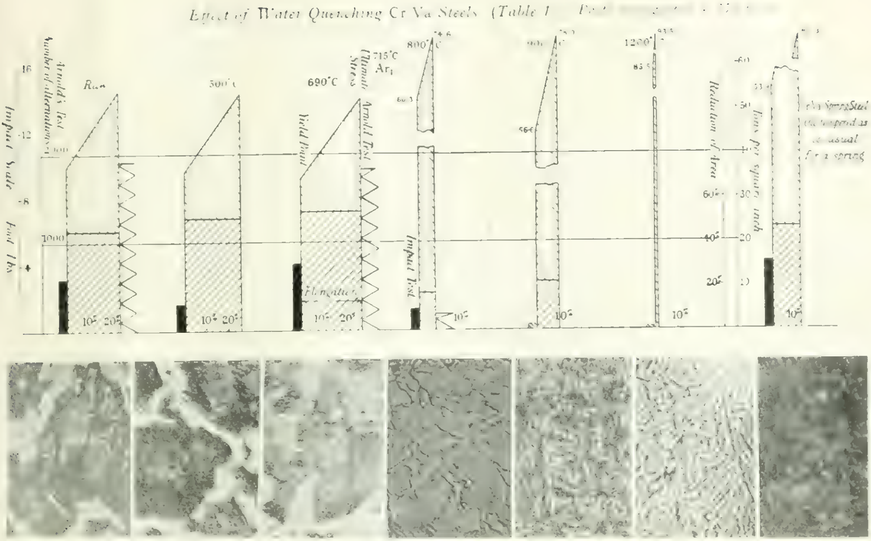

Effect of Water Quenching Cr Va Steels (Table I
Arnold's test
Number of alternations
Impact Scale
Foot lbs
Raw
500°C
690°C
715°C
Ar₁
800°C
1200°
Ultimate Stress
Yield Point
Arnold Test
Impact Test
Elongation
Reduction of Area
Tons per square inch
Spring Steel
tempered as usual for a spring
2000
1000
16
12
8
4
10%
20%
60%
40%
60
50
40
30
20
10
85.5
93.5
56.6
53.4

FIG. 3.

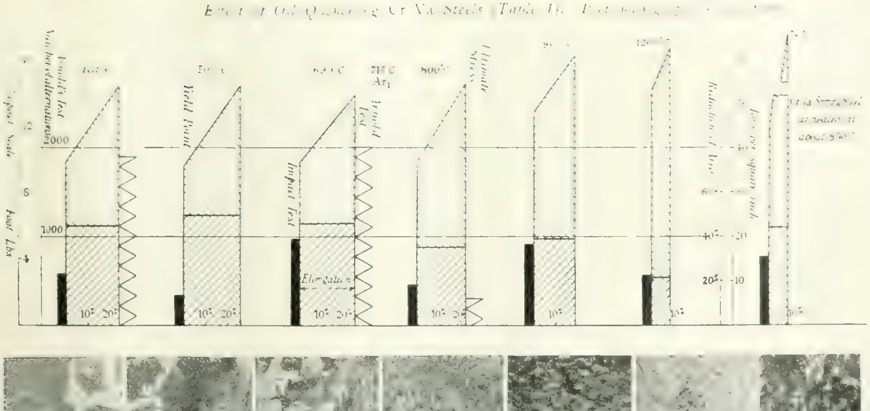

Effect of Oil Quenching Cr Va Steels (Table II.
Arnold's test
Number of alternations
Impact Scale
Foot lbs
500°C
715°C
Ar₁
800°C
Ultimate Stress
Yield Point
Arnold Test
Impact Test
Elongation
Reduction of Area
Tons per square inch
Spring Steel
2000
1000
12
8
4
10%
20%
60%
40%
40
20
10

FIG. 4.

[illegible]

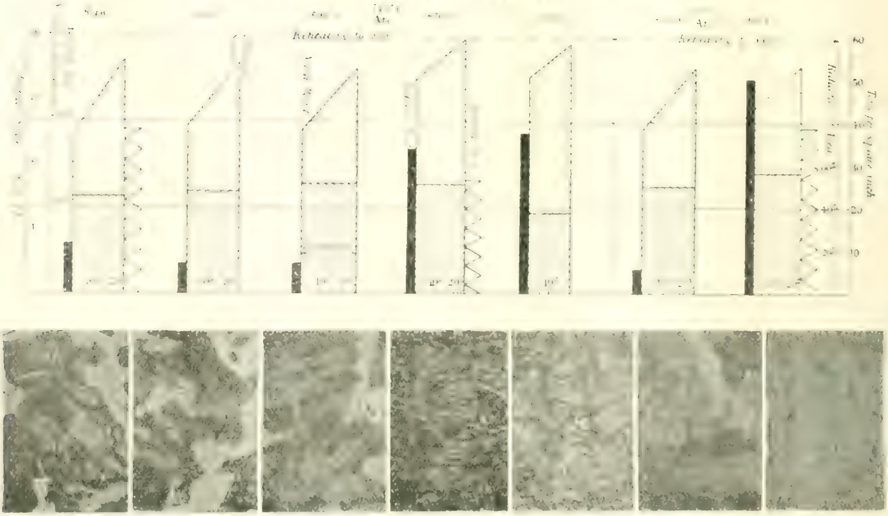

Reduction of Area
Tons per square inch
60
50
40
30
20
10

FIG. 5.

[illegible]

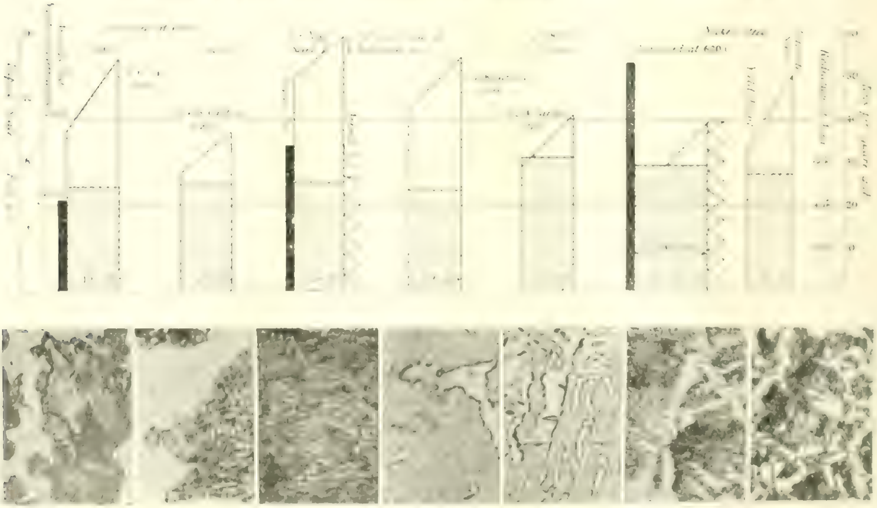

Annealed at 620°
Reduction of Area
Tons per square inch
50
40
20
0

FIG. 6.

the right angles bent was 16, whereas, when oil quenched at 800 deg. C., the test piece snapped at 30 forward. The oil tempering series shows no very marked effect at the critical temperature on the mechanical tests, except a considerable increase in the yield point, but the photo-micrograph section shows an entirely different structure—as will be seen in fig. 5 (photo-micrographs, Nos. 3 and 4). In the case of the latter it will be noted that the high elastic limit is attained at some sacrifice of the ductility, and of the resistance to alternating stresses. By quenching at 1,000 deg. C. a martensitic structure is obtained (photo-micrograph No. 5, plate 5), which is not broken down sufficiently by tempering at 350 deg. C. to render the material a safe one for anything but "steady" loads.

Comparing photo-micrographs quenched below Ar1 and quenched above Ar_1, and both subsequently reheated to 600 deg. C., it will be seen that the structure is entirely different in the two cases, though the tensile tests remain somewhat constant; at the same time, the resistance to impact has enormously increased, and the resistance to alternation-of-stress has been completely brought back to its original figure.

It is seen from some of the examples that oil tempering, although it does not very materially alter the tensile tests, has an enormous effect on the impact figure. It would not appear from the tensile tests alone in some examples that the steel is in a ruined condition, although it really is so, as is shown by Arnold's test (only 868 alternations as against 2,000), and photo-micrographs No. 7, fig. 2. The impact tests group themselves into very low average figure with good agreement in readings, medium average with great variations in readings, and good and very good average with agreement in readings. The illustrations show how these three groups are made up, the first being that of "ruined steels," the second that of raw steel where heat treatment has taken place below the critical temperature (Ar_1). The figures show that the average impact test figure varies more with the heat treatment than the tensile tests.

In the hand-bending test, the results of which are given in the table on page 974, the great superiority of the chrome-vanadium steel and of the nickel steel is very marked. The fractures produced by the hand-bending test follow to a certain extent the impact fractures (see figs. 1, 2 and 4).

In the raw chrome-vanadium steel, and also when heat-treated below the Ar_1 point, the ferrite is principally arranged in meshes, whereas in the pure carbon-steel it is more in the form of lumps. The structure of the chrome-vanadium steel annealed *above* the Ar_1 point, is, however, similar to that of the pure carbon-steel, as will be seen by examining photo-micrographs Nos. 5 and 6, fig. 1.

The alteration in the structure produced at 800 deg. C. (1,472 deg. F.) is continued to a slight extent when soaked at this temperature, as also when soaked at 900 deg. C. (1,652 deg. F.); but annealing for half-an-hour only at 900 deg. C. and 1,100 deg. C. (2,012 deg. F.) appears to diffuse the cementite. At the latter temperature well-marked ferrite boundary lines are obtained. It is to be noted that this latter treatment has largely brought back the original tensile strength of the metal that had been lost in annealing at 800 deg. C. and 900 deg. C., though the resistance to impact of the material is very poor and irregular. The effect of soaking at 1,200 deg. C. (2,192 F.) is to produce large ferrite crystals and to render the carbide massive, and the structure is obviously ruined; the mechanical tests do not, however, suffer as much as might be expected, the impact figure is even improved and is more regular, but, except Professor Arnold's alternation test, is decidedly reduced. (Nos. 1 and 7, fig. 2.) It will be noted that in every case except where such treatment ruins the steel, the chrome-vanadium steel is distinctly less sensitive to heat treatment than is the pure carbon steel, and the impact figure considerably larger.

A further comparison is made in plate 6 between annealed chrome-vanadium steel and annealed 0·468 carbon-steel, also between oil-tempered chrome-vanadium steel (photo-micrograph, No. 3) and oil-tempered 0·468 and 0·254 carbon-steel; and the strong similarity between the annealed chrome-vanadium, and the oil-tempered 0·468 carbon-steel shown therein appear to the authors to be an important point, because in the case of the annealed chrome-vanadium steel the characteristics are maintained throughout the mass, whereas in the case of an oil-tempered steel in large masses it depends entirely on circumstances as to the depth the effect penetrates. The oil-tempering of chrome-vanadium steel, however, further improves its quality, especially in regard to the elastic limit and resistance to impact, but it is to be noted that in this case the alternations (Arnold's test) are diminished; here the tempering has not been quite powerful enough for the quenching, and a higher re-heating temperature appears desirable.

The diminished sensitiveness to heat treatment is, it need hardly be said, a matter of the greatest practical value. It is important to note, however, that if the tensile strength is to be maintained the annealing temperature should not exceed 650 deg. C. (1,202 deg. F.), but if the best all-round result is required, then the annealing temperature should be 900 deg. C.

OUR WEEKLY BIOGRAPHY.

MR. JOSEPH HENRY COLLINS, F.G.S.

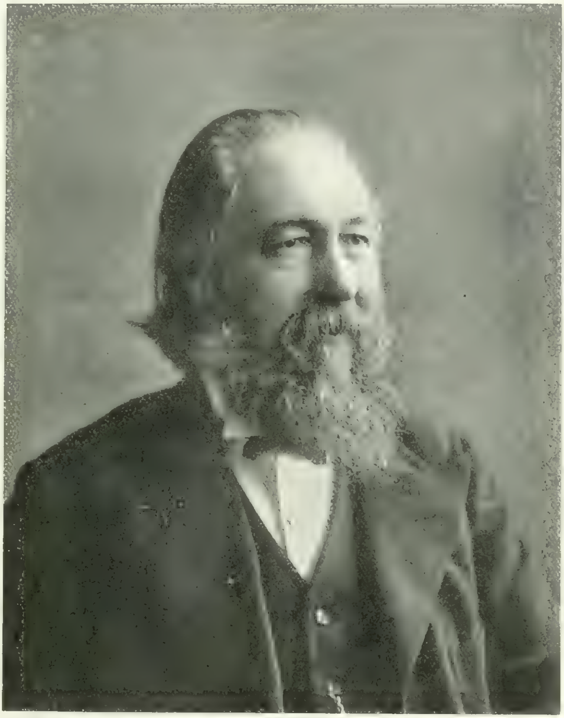
MR. JOSEPH HENRY COLLINS, F.G.S., was born in London in 1841. During the early part of his career he lived in Derbyshire, where, as the result of frequent visits to the Matlock Caves and fossiliferous hills of Crich, while still very young, he acquired a taste for geological and mineralogical studies which had a permanent effect on his after life. In 1850 he returned to London, and a few years later he was articled to a decorative sculptor, which profession he followed with marked success until he reached the age of twenty-seven, when he happily reverted to scientific pursuits.

From 1864 to 1868 he was an occasional student at the Museum of Practical Geology, and Royal College of Chemistry, where he had the advantage of instruction from Professor Hoffman. In May, 1868, he was a successful competitor for one of the Royal Exhibitions at the Royal School of Mines, and subsequently he accepted an appointment as Lecturer and Assistant Secretary to the Miners' Association of Cornwall and Devon. Later on he became Secretary of the Cornwall Polytechnic Society; also of the Royal Institution of Cornwall, and, for a time, was Curator of the Royal Geological Society of the same county. About this time he was elected member of the general committee of the British Association.

In 1873, Mr. J. H. Collins commenced to practice as a consulting mining engineer. Shortly afterwards he was appointed Public Analyst for the county of Cornwall, and later on he held a similar post for several other Cornish boroughs. In [illegible] the Rio Tinto Company [illegible] him a position as chief chemist and metallurgist at their mines in Spain. Having accepted their proposal, in February, 1881, Mr. Collins proceeded to Spain to enter upon his duties, but before leaving Cornwall he was the recipient of several valuable testimonials in recognition of his scientific services to the county. After about three years abroad Mr. Collins found it necessary to resign his post in consequence of the climate of the Rio Tinto district having proved injurious to his health. He returned to England, and resumed practice in London as a consulting mining and metallurgical engineer. Since that year he has been continuously engaged in the practice of his profession—in this capacity he has frequently visited Canada, the United States, Mexico, Lower Burma, Hungary, Norway and Sweden. Associated with the firm in London is his son, Mr. Henry Francis Collins, A.R.S.M.

A frequent contributor to the proceedings and transactions of several technical societies, Mr. Collins is also the author of the authoritative "Handbook to the Mineralogy of Cornwall and Devon," and the translator of M. Leon Moissenet's "Rich Parts of the Lodes of Cornwall."

In 1869 he was elected a Fellow of the Geological Society of London. A few years later he was one of the founders of the Mineralogical Society of Great Britain; he is also a member of the Society of Arts, and of the Society of Chemical Industry. When the Institution of Mining and Metallurgy was established he was appointed a member of the Council, and was, a few years later, elected President. He has also served as President of the Royal Geological Society of Cornwall.



MR. JOSEPH HENRY COLLINS, F.G.S.

Babcock & Wilcox Coal Handling Plant at Brimsdown.

THE subject of mechanically handling materials in large quantities is now receiving much attention amongst engineers generally, and more particularly amongst engineers of electric lighting and power stations, where large quantities of coal are annually used. By the courtesy of Messrs. Babcock & Wilcox we illustrate on pages 981 and 982 the conveyor erected by them for the Metropolitan Tramways Electricity Works at Brimsdown.

The simplest manner of representing the saving which can be affected by conveying machinery is, perhaps, in cost per ton of coal, and when this cost falls from say 6d. to ½d. or ¾d. it is a simple calculation to find the annual saving in the coal-handling bill. Thus, suppose a power-station uses 10 boilers, each consuming one ton of coal per hour, of 10 hours per day, and 300 days per annum, the total cost used will be 10 by 10 by 300 = 30,000 tons per annum ; therefore, the cost would be, at ¾d. per ton, £93 15s. by the conveyor method of handling, against £750 per annum at 6d. per ton by the old system, leaving a net saving of £656 5s.

It is claimed that the Babcock & Wilcox "Gravity-Bucket" conveyor has proved equal to, and has, in many cases, exceeded this saving, for when working under the best conditions, it shows a cost of less than ½d. per ton for the complete conveying and elevating process, while it may be taken as a minimum cost of handling by manual labour, that 2d. per ton must be expended for simply shovelling over, without conveying or elevating.

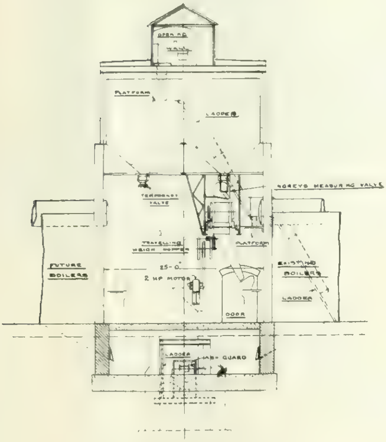
The conveyor is in reality a series or train of tipping cars linked together and perfectly balanced.

A feature in this conveyor which contributes very largely to its low cost of working and efficiency is the method of driving employed. The driver may be actuated by any motive power obtainable, and consists of a spur-geared engine operating two sets of pawls. The latter drop into position on the chain at the correct points, and thrust forward the two sides simultaneously. Before leaving its position on the driving stud of the chain the pawl recedes to a considerable extent from it, so that no friction is experienced in withdrawing the pawl from the chain, and over and above this, the withdrawal leaves a very considerable latitude for wear in the chain, without in any way affecting its efficiency, or that of the driver.

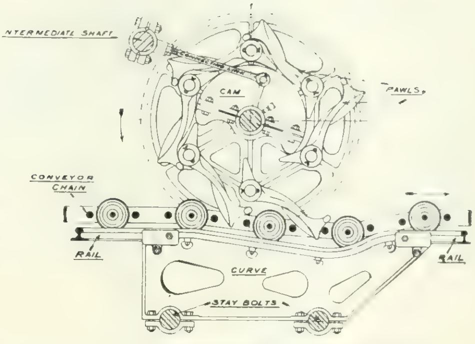
Another special feature of the conveyor is the application of free or revolving curves, where the direction of the conveyor is changed, either from the horizontal to the vertical in the same plane, or at any angle to the first plane of motion. In descending from an upper run to any depth, the maximum stress is at the point of turning to descend, and here the wheels carrying the chain and buckets cease to rotate as soon as they touch the revolving free-wheels, and when movement ceases friction also ceases, and consequently wear on the chain, wheels, and axles.

The power required to drive a Babcock & Wilcox conveyor can be easily estimated with fair exactitude, and should be taken as made up of two parts : first the power to drive the conveyor empty ; and secondly, the power required to raise a certain weight of coal per minute through a given height. Experiment has decided the first ; and the second is the mechanical equivalent of the work done.

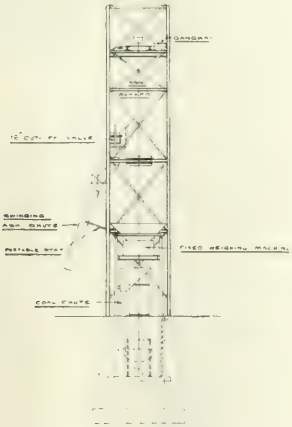
The conveyor is practically automatic in its cycle of action, no handling being necessary from the point at which the material is delivered into the receiving hopper until it is "discharged" further than moving the levers of the dumpers to fill up the bunker sections requiring to be operated on. The general construction of the conveyor will be seen from the illustrations.



CROSS SECTION AT A A

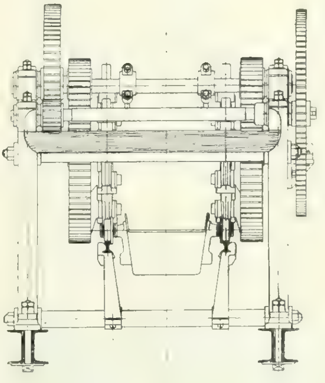


ARRANGEMENT OF DRIVER PAWLS



ASH TOWER

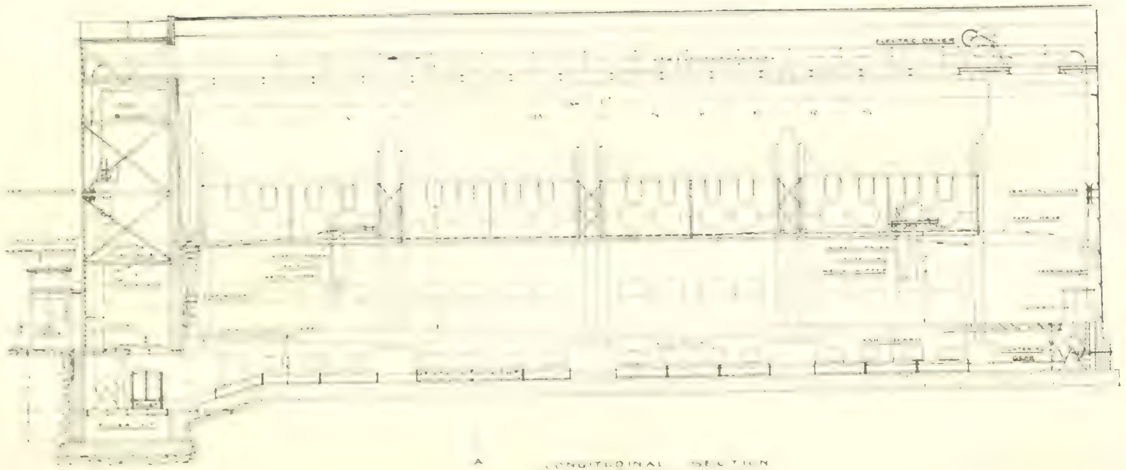
FRONT ELEVATION



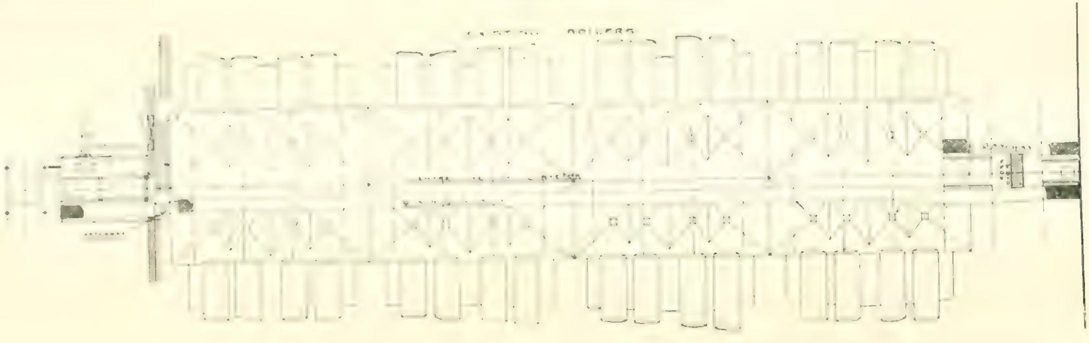
END VIEW WITH MOTOR REMOVED

General arrangement of the driver and pawl mechanism. The driver is actuated by an electric motor, geared direct.

THE BRIMSDOWN CONVEYOR PLANT.



A LONGITUDINAL SECTION



PLAN

BABCOCK & WILCOX CONVEYOR AT THE METROPOLITAN TRAMWAY POWER STATION AT BRIMSDOWN.

Capacity 40 tons of coal per hour

WEST VIEW OF THE PUYALLUP POWER HOUSE, WITH FOUR GENERATORS IN OPERATION.

THE PUYALLUP RIVER WATER POWER DEVELOPMENT.

THE cities of Seattle and Tacoma, Washington, and their suburban towns, have in five years increased in population from 130,000 to upwards of 225,000; and, to supply the consequent demand for electric power, an unusually large generating plant of the most modern type has been constructed on the Puyallup River.

The Puget Sound Power Company, the owner of the plant, was organised in the year 1902, and a general plan was adopted for the development of power on the Puyallup River with an initial installation of 20,000 h.p. The design consists of diverting the Puyallup River just below the junction with the Mowich, and carrying the same by means of a flume ten miles to a reservoir located on a high plateau, and thence discharging by means of steel pipes against wheels in the power house under a head of 872 ft., the water wheels so driven to be direct connected to electric generators, and the electric power so produced to be transmitted at a pressure of 55,000 volts forty-eight miles to Seattle and thirty-two miles to Tacoma. The first generator unit of 5,000 h.p. was put into commercial operation delivering power to Seattle and Tacoma on April 14th last, less than fourteen months after work was commenced; the plant was put into complete operation for its initial installation of 20,000 h.p. on July 23rd, 1903.

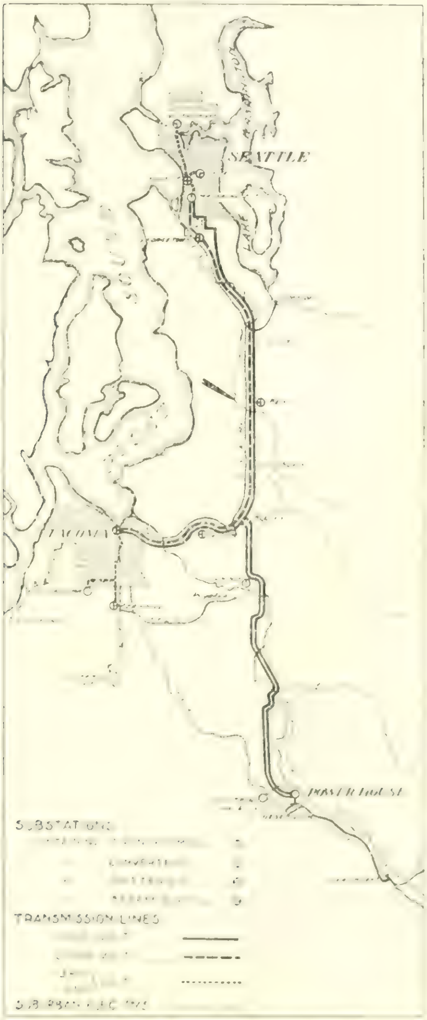
The Puyallup River has its source in the glaciers of Mt. Rainier, next to the highest mountain in the United States, and one of the great peaks of the world, covering 200 square miles and rising 14,500 ft. above the waters of Puget Sound.

The Puyallup and Mowich rivers drain a fan-shape section of the mountain and its glaciers. Although the dam and intake are located within ten miles of the nearest glacier, the elevation at this point of diversion is only about 1,700 ft. above sea level, and the climate at this elevation is so uniformly mild and the

INTAKE AND DAM, LOOKING EAST.
Showing incompleted radial gate at the lift.

[illegible] nor is formed either in the flume or reservoir.

The power is used for all branches of service—light, power, and railway. It supplies the electric railway [illegible] of trolley road, the multiple unit, third rail line between Seattle and Tacoma, two cable roads, one in Seattle and one in Tacoma, furnishes power for numerous factories, together with the shops of the Northern Pacific Railway and the new pumping plant of the city of Tacoma, and supplies the greater portion of commercial and residence lighting and street lighting in Seattle and in the towns between Seattle and Tacoma.



[illegible] THE [illegible]

Much of the power is distributed as alternating current—two-phase for power and single-phase for lighting—but there is also connected 10,000 kilowatts of converting capacity for producing direct current, 2,000 kilowatts of which is used for light and stationary motor supply. The bulk of the converting machinery (7,300 kilowatts) being of the synchronous type, it is not necessary for the water power plant to generate or transmit idle currents.

The distribution of the current to the various localities, and the transformation and conversion for various uses takes place at eleven sub-stations, containing 26,000 kilowatts of transformer capacity. Six of these are designed for transforming the 55,000-volt current to lower voltage and eight contain machinery converting to direct current for railway use.

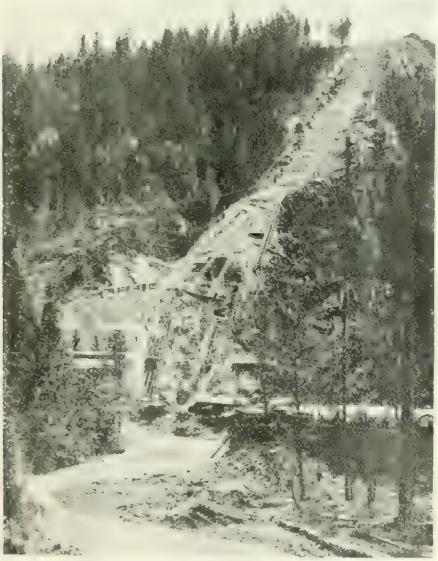
DAM AND INTAKE

At a point one-half mile below the confluence of the Puyallup and Mowich rivers, and about 1,700 ft. above sea level, is located the dam and intake of the Puget Sound Power Company. Here the water necessary for the operation of its plant is diverted by a low, solidly constructed dam, through a masonry intake, to a flume which is constructed on the South-West side of the river for a distance of ten miles. The dam or diverting weir is 200 ft. long, and 5 ft. high, and covers the bed of the river longitudinally for a distance of 60 ft., exclusive of the down stream apron.

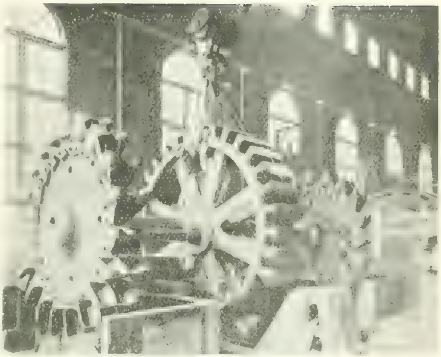
It is built down to an impervious bottom of clay hardpan, and is made tight by three rows of triple lap sheet piling set into hardpan bottom and bedded in concrete. It is faced with 6 by 12 timber, covered at the crest with one-quarter-inch boiler plates, and besides the whole dam being a spillway, there is a lower spillway 30 ft. wide to localise scour at the intake end. The intake is set at right angles to the dam and is constructed of concrete masonry. It is 62 ft. wide at the river bank, and is protected by a screen grating made of iron bars one-quarter-inch by 4 inches by 6 ft., spaced 2½ inches. Provision is also made for the insertion of flash-boards in grooves in steel frames in such a manner as to regulate or entirely shut off the intake at a point between the river and the grating. A radial gate of special design is also installed at the junction of the masonry intake, and the flume for the purpose of quickly controlling the amount of water delivered to the flume. From head works to reservoir, a distance of about 10 miles, the water is carried in a flume 8 ft. wide, and 5 ft. high, inside measurements, the depth of water being at all times shown at the power house switchboard by a Dibble automatic electrical indicating and recording water gauge fitted with low water alarm. This gauge is operated by three wire running from a float-actuated Dibble transmitter located in the reservoir.

PENSTOCKS

The penstocks, one for the two exciters, one for each of the four generating units now installed, and one for each of the remaining four units to be installed later, are carried through the reservoir embankment in the form of concrete protected wood stave pipes, joining the steel pipes just outside the reservoir embankment. Of the eight main pipes for the complete plant, four, together with the exciter pipe, are now continue about 1,700 ft. down an incline of about thirty degree to the power house on the river bank below. Each main pipe [illegible] steel 42 in. in diameter, and ¼ in. thick at the upper end, tapering to 36 in. in diameter, and ¾ in. thick at the lower end. The penstocks are anchored by massive concrete abutments, and all surface water is carefully drained away, and as a further security the pipes are protected with back filling of earth on which is planted quick growing vegetation.



POWER HOUSE, SUPERINTENDENT'S COTTAGE, AND PENSTOCK LINES, LOOKING SOUTH.



PLACING THE WATER WHEELS AND ROTOR SHAFT OF A SINGLE UNIT IN ITS BEARINGS.

THE POWER HOUSE.

The power house is built on the bank of the river on a foundation of piling and rock ; it is of massive concrete, brick and steel construction ; the building for eight units will be about 100 by 266 ft., divided longitudinally into two parts, a generator house, and a transformer and switching house. The generating units are arranged parallel to and along the river side of the building, the penstocks being brought to them under the main floor from the rear. The transformers are grouped in isolated rooms of concrete in the basement of the switch house, the switching apparatus and wiring being in compartments overhead.

PELTON WHEELS.

Each unit consists of two overhung Pelton water wheels, 10 ft. 6 in. in diameter, mounted on each end of the shaft of each 5,000 h.p. two-bearing generator ; the nozzles are of the needle type arranged for automatic deflection by Lombard type L governors for speed control, the operation of the needles being only for economic adjustment of the discharge to the load of the machine ; each nozzle is also provided with a motor-operated gate valve for cutting off the water supply. The wheels have a maximum capacity of 7,500 h.p. for each unit.

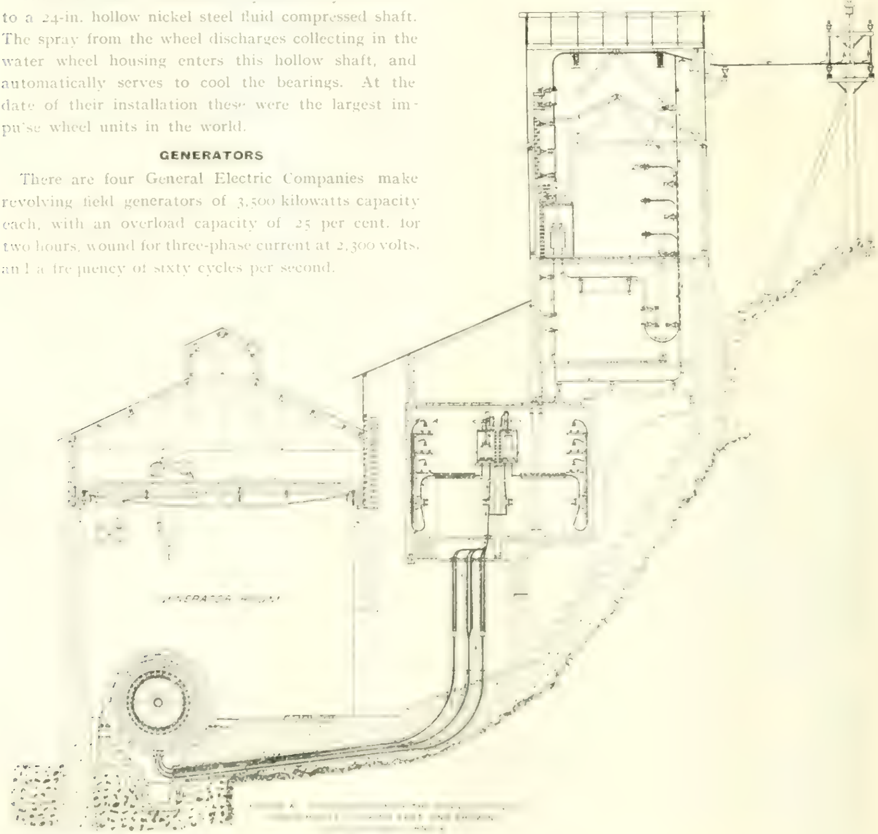
The wheels are arranged to be started and stopped and adjusted for speed from the main operating switchboard at one end of the generator room; motor-driven pumps provide oil supply for ordinary lubrication, pressure for forced lubrication in starting, and circulating water for cooling bearings.

The rotors and wheels are hydraulically forced on to a 24-in. hollow nickel steel fluid compressed shaft. The spray from the wheel discharges collecting in the water wheel housing enters this hollow shaft, and automatically serves to cool the bearings. At the date of their installation these were the largest impulse wheel units in the world.

GENERATORS

There are four General Electric Companies make revolving field generators of 3,500 kilowatts capacity each, with an overload capacity of 25 per cent. for two hours, wound for three-phase current at 2,300 volts, and a frequency of sixty cycles per second.

purpose, and operate either as motors or generators according as they run below or above synchronous speed. The motors also afford a relay source of power for excitation in case of failure of an exciter water wheel or its water supply. Each exciter is capable of exciting six generators under all conditions.



[illegible]

[illegible] direct connected to an overhung Pelton water [illegible] phase induction motor. The wheels driving exciters [illegible] he direct connected induction motors serving this

[illegible] kilowatt, water cooled, oil insulated, General Electric [illegible] capacity for two hours.

[illegible] switchboard gallery, a water wheel may be started or stopped, a generator brought up to voltage, synchronised with other generators on either bus, a transformer bank cut in on either bus, and a transmission line connected in circuit without the presence of a person in the room where the actual switching is done, the lighting of a red lamp indicating the closing of a switch and a green lamp the opening of a switch.

SWITCHES, ETC.

Figs. A and B show sections through the generator room and switch house. The transformer rooms are at the same level as the generator room, but isolated from the latter by rolling steel doors. On floor No. 2 are the low tension disconnecting switches, the generator and transformer cables going to the sets of disconnecting switches on either side of the middle partition ; the

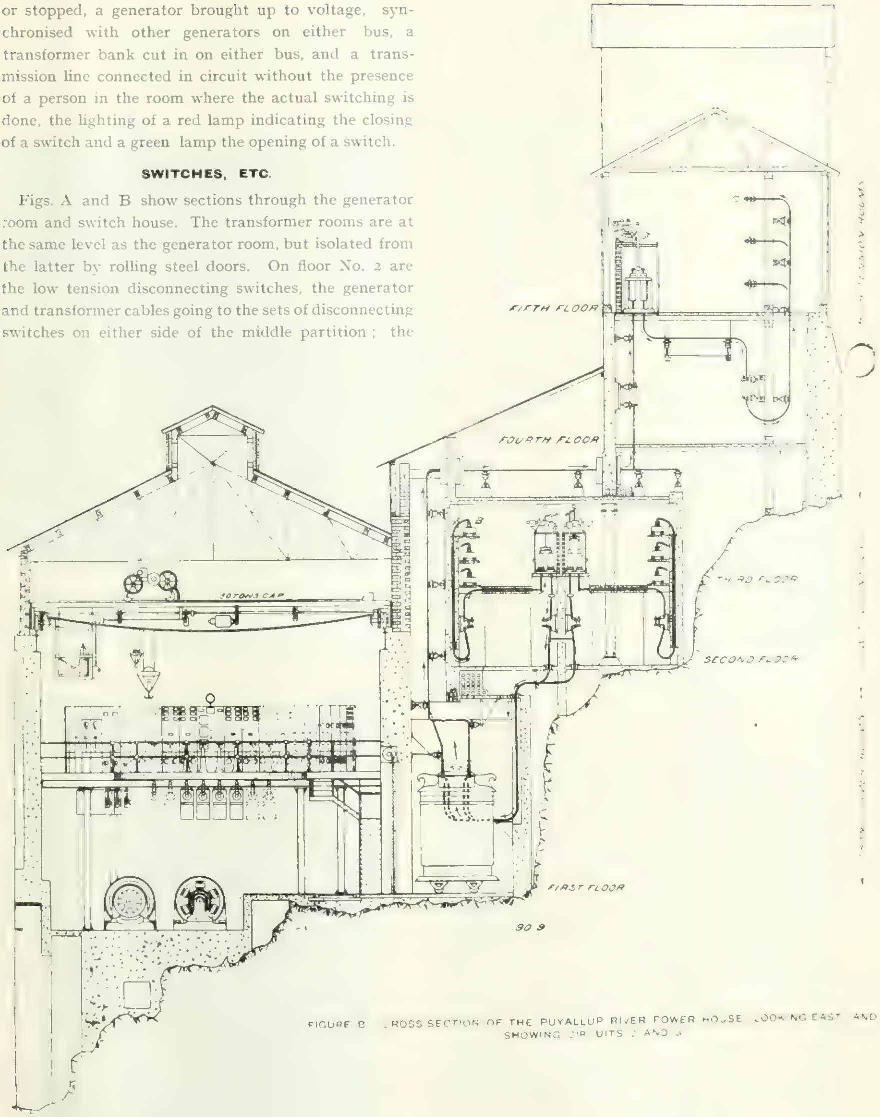


FIGURE B.—CROSS SECTION OF THE PUYALLUP RIVER POWER HOUSE LOOKING EAST AND SHOWING CIRCUITS 2 AND 3 disconnecting switches installed between the oil switches and the bus being on the outer walls and immediately below the busbar compartments, which are above on floor No. 3. In the centre of floor No. 3 are the low tension oil switches, the two oil switches corresponding to a generator or transformer bank being arranged back to back, and facing their corresponding set of busbars. The busbars are of the laminated type, consisting of flat copper bars with expansion joints and supported on marble slabs set on edge which in turn rest on concrete slabs forming barriers between adjacent busbars. The compartments formed by the concrete slabs are to be covered by insulating fireproof doors.

The oil switches are installed in brick cells with soap-stone bottom and top slabs and doors. Each pole of a switch is separated from the other poles by brick barriers.

The same general scheme is laid for both the low and high tension disconnecting switches and oil switches, except that only one set of high tension busbars is at present installed, provision being made for the later installation of the second set. The high tension disconnecting switches and current transformers are on floor No. 5, while the high tension oil switches are on floor No. 6. Above floor No. 6 are the two outgoing high tension line towers, in the north end of which are the high tension lightning arresters, each pole being separated from its adjacent pole by brick barriers extending the full length of the arrester. The lines emerge from the wire tower centrally through an extra-heavy 30 in. sewer tile covered by a glass plate.

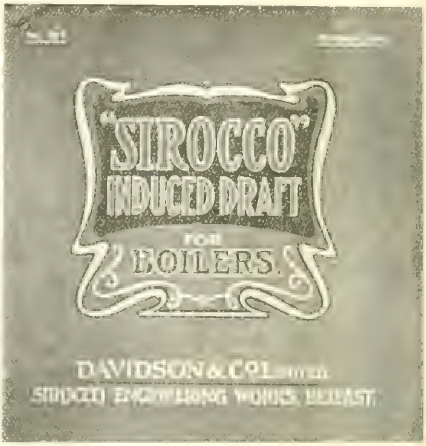
SPECIAL FEATURES.

[illegible] rily to insure uniform and uninterrupted service. Continuity of service has been insured by the greatest solidity of construction in every part; by duplicate busses and switches at the power house; duplicate transmission lines and spare transformers at each end of the transmission line, so that all repairs can be made without discontinuing service, and by having in all the electrical machinery an overload capacity of from 25 per cent. to 50 per cent.

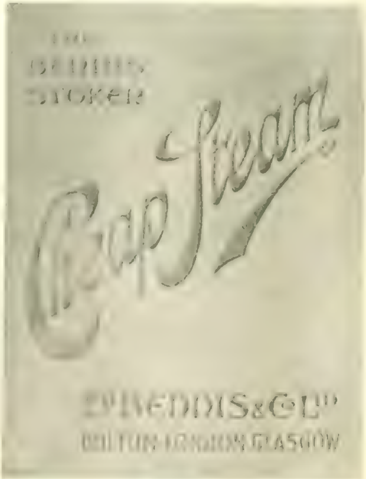
In addition to this there are in reserve in Seattle and [illegible] capacity, and six storage batteries of 2,700 kilowatts aggregate capacity, all electrically inter-connected with each other and with the water power plant, and ready for supplementary and relay service. For the above details and illustrations of this interesting plant, we are indebted to the Journal of Electricity, Power, and Gas, published at San Francisco.

CATALOGUE DESIGN.

MESSRS. Davidson and Co., Ltd., have issued a very near pamphlet on their "Sirocco" Induced Draft for Boilers, the cover being executed in brown, black, and gold. This pamphlet has some excellent line and half-tone illustrations.



The cover [illegible] pamphlet [illegible] Bennis Stoker and Compressed Air Furnace, issued by Messrs. Ed. Bennis and Co., Ltd., of Bolton, London, Glasgow, etc., and illustrated below, is rendered in bronze, upon a background [illegible] green.



DECEMBER NOTES ON SHIPBUILDING.

SOME RESULTS OF 1904.

The shipbuilding records for the year are not complete while we write, although numerous statements have been issued by the newspapers. As these are estimates including items which are still on the stocks, we prefer to wait for realised facts before presenting our conclusions; but it would appear that the expectation of a short-fall upon 1903 will not be realised. At all events, during the eleven months ending November 30th, the vessels launched in the United Kingdom aggregated about 1,150,000 tons, as against about 1,111,000 tons in the corresponding portion of 1903, the gain thus shown being in English yards. Amongst the returns we have received from shipbuilders in all parts of the country are many examples of the vicissitudes of the industry. For instance, Messrs. Caird and Co., of Greenock, the builders of the P. and O. fleet and of numerous famous monsters, in the year just closing have put into the water only one single-screw steamer of 3,021 tons, for Australia, and one twin-screw steamer of 1,996 tons, for Ireland. A total of 5,000 tons is a negligible quantity in this enormous yard, where, however, several P. and O. boats are now under construction and will figure in the 1905 returns. Not much short of the same tonnage—or say 4,616 tons—has been turned out by Messrs. Mackie and Thomson, at Govan, but in 13 vessels, ranging from 90 to 1,800 tons each, including one 200 tonner and one 250-tonner for France. The Dublin Dockyard Company have been making up for some of the decrease that Belfast will show by turning out four steamers of 1,700 tons. Messrs. Joseph Scarr and Son, of Beverley, have turned out 2,051 tons of sloops, lighters and barges, as against 1897 tons in 1903. At Leith, Messrs. Ramage and Ferguson have turned out 8,900 tons in six vessels ranging from 66 to 626 tons each. And at Leith Messrs. John Cran and Co., have engined eight small steamers, (four for the Admiralty) besides building two. We shall, however, review the whole situation in the New Year.

ADMIRALTY CONTRACTS.

Undoubtedly the shipbuilding world is somewhat puzzled at the Admiralty's policy, and would have liked a good deal more of the Admiralty work than it has at present. On the Clyde, for instance, the builders (even those on the Admiralty list) cannot understand why they are never asked to tender for destroyers. It is not that they cannot build them, for they have built a score or two of this class of vessel for foreign navies, and in a remarkably short space of time. Indeed, there seems no species of floating craft that has not been built on the Clyde, and that cannot be built there as well and as cheaply as anywhere else. One of the fastest destroyers now afloat was built on the Clyde, but nowadays all the Admiralty orders for these craft go to English yards, and Clydesiders want to know the reason. They have certainly a couple of experimental tanks there which no other shipbuilding district in the country has. And if the turbine is to be the motor of all swift vessels in the future, then Clyde builders have done more than any others to bring the turbine into practical use, though the machinery was first made on the Tyne.

THE KHEDIVE'S YACHT.

It appears that the yacht of the Khedive of Egypt is to be fitted with turbine machinery, and is being sent to Messrs. A. and J. Inglis, at Glasgow, for the purpose. This will be the first royal yacht into which turbine machinery will be fitted. She was, however, built as far back as 1866 by Samuda Bros., London, for the famous and extravagant Ismail Pasha, who backed up the French Canal scheme and gave his name to the new City of Ismailia, which the canal created. She is a paddle boat with low pressure boilers, and it seems strange that the present Khedive should think it worth while to renovate her. This yacht, *Mahroussa*, was fitted up in such magnificent style by the gorgeous Ismail, and has been kept all these years in such splendid condition, that it would be a pity to destroy her. She is, too, of great size—400 ft. by 42 ft. beam and 26 ft. 5 in. depth—so after careful inspection by yacht experts, it has been decided that she is worth altering, notwithstanding her two-score years (nearly), and she is being sent to Messrs. Inglis' yard—whence so many famous yachts (as well as B. I. steamers) have sprung, in order to be converted into a screw, with turbine machinery and a new suit of boilers.

THE SUEZ CANAL CONTROVERSY.

In our last notes reference was made to the correspondence between the Chamber of Shipping and the Board of Trade on the subject of the Suez Canal charges on enclosed spaces in steamers. That correspondence produced a lengthy letter from Prince d'Arenberg, chairman of the Canal Company, which has deepened the feeling among British shipowners from irritation into indignation. In fact, there is a gathering force of resentment against the French Company and its administration, just as some of us can remember there was a number of years ago, when the great De Lesseps had himself to come (metaphorically) with hat in hand to London and purchase a continuance of British custom by much amiability and some concessions. It seemed very possible then that an altogether independent canal might be constructed. It is becoming tolerably certain now that a new waterway will be thrown across the Egyptian Isthmus by British capital and skill, and under British administration. Of course, under modern conditions and with acquired experience, it will not cost anything like what the Lesseps canal cost, and even that can pay 25 per cent. on its enormous capital. Two competing canals will not, perhaps, both pay, but a well-managed British canal will yield a percentage when the old canal will not. Of course there is the serious aspect of the business for us also, for Great Britain as a nation holds a very large quantity of Suez Canal stock. No Chancellor of the Exchequer can with equanimity contemplate the prospect of that stock becoming dividend-less. But neither can British shipowners contemplate with equanimity the prospect of being perpetually snubbed and sweated by a French Company.

SHIPBUILDING LABOUR COSTS.

It is a comforting thought at the close of the year that the twelve months have passed without any of the numerous labour disputes in the industry ending in serious conflict. It is still more comforting to know that in the district where danger most threatened an arrangement has been effected which will preserve the peace for at least three months. On the North-east coast the shipbuilders and their employees have come to terms by exercising diplomacy and good temper. The employers adhere strongly to their contention that a reduction in wages, which they place at 5 per cent. on piece rates, and 1s. 6d. per week on time rates, is absolutely essential to the health, if not the life, of the industry. They wanted the reduction some time ago, and they wanted it at once, but out of consideration for the difficult position of the leaders of the several trade unions concerned, they did not enforce the reduction while the matter was being discussed and negotiated. Finally, the boilermakers and shipbuilders agreed to accept the reduction for three months, provided it did not begin until January 1st. The employers consented to this postponement, and tardily the rest of the Trade Unions have concurred. So the new year will begin on the reduced scale of pay, and the employers hope that this will enable them to cut in more cheaply for new orders. But, on the other hand, material has again advanced, Scotch steel makers having put up their price for steel ship plates to £5 17s. 6d., less 5 per cent., followed by the North of England steel makers, who have put up ship plates to £5 15s., and angles to £5 5s., less 2½ per cent. As yet, no proposal has been made to reduce either shipyard or engineering labour in Scotland, but the number of unemployed men this winter is considerable.

AMERICAN SHIPBUILDING.

Sir William H. White, K.C.B., is contributing a series of articles to the Times, based upon his recent visit to the United States, giving a summarised statement of naval construction now in progress, and estimating the capabilities of the States for building ships of all classes, for war and for commerce. He points out that in all recent American ships electrical power exclusively is employed for loading and working heavy guns, hoisting ammunition, lifting boats, and other auxiliary services. No hydraulic machinery is now used. Undoubtedly there is complete control, great rapidity in operation, and many advantages in the leads and protection of wires. In addition, very elaborate arrangements are made for the transport and supply of ammunition, mechanical appliances being freely used. It is claimed that an adequate supply can be secured even with the most rapid rate of firing. Since the war with Spain great attention has been given to the improvement of naval gunnery, and good results have been obtained both as regards accuracy and rapidity. The system of mounting and working heavy turret guns is stated to be satisfactory, and to have enabled as rapid a rate of fire to be obtained as we have achieved with our most improved arrangements. "Personally," continues Sir William, "I doubt if this could continue over any long period in action; and, in addition, accidents like that in the *Missouri* have shown that the American system is accompanied by certain risks not occurring with the British system." At present the whole subject is being re-examined and changes may follow. At St. Louis, in the exhibit of the Bethlehem Company, a full scale model was shown of 12-in. guns mounted in a turret, the system in its essentials closely resembling that which our experience has shown to be best, although electrical power has been substituted for the hydraulic system adopted in the Royal Navy.

THE WEEK AMONG THE TECHNICAL SOCIETIES.

INSTITUTION OF ELECTRICAL ENGINEERS.

(MANCHESTER STUDENTS' SECTION.)

WORKING OF BATTERIES UNDER REVERSIBLE BOOSTER CONTROL.

At the meeting held on the 16th inst., a paper on this subject was read by Mr. Eric D. S. Shelmerdine, of which the following is an abstract.

The author, on the general question, pointed out that a battery in a small station is practically useless without the booster. He divides his subject into three parts; the battery, the booster, and the relation of one to the other. Having described different forms of battery and the diseases to which a battery is subject, he passes on to the consideration of his main point, the Automatic Reversible Booster.

Broadly, of course, the function of the booster is to cause the battery to discharge at times of heavy load, and charge at times of light load, so keeping the load on the main generators practically constant.

The booster armature is in all cases connected in series with the battery; it can be looked upon for the time being as a dynamo, with the field magnets so arranged, that under certain conditions it will generate a pressure in one direction, and under other conditions it will generate a pressure in exactly the reverse direction. The battery and booster together are connected in parallel to the main generators, therefore, if the booster is adding its pressure to that of the battery, it will tend to lift the sum of the battery and booster pressure up above the pressure of the bar, and so cause the battery to discharge.

On the other hand, if the booster pressure is working in the opposite direction to the battery pressure, the obvious result will be that the battery pressure will drop, until it is less than the pressure of the bar, and so cause the main generators to charge the battery.

All that is required now, is, that these alterations in pressure shall occur at the correct moment, and to show how these results are obtained, it will be necessary to describe several different makes of boosters.

HIGHFIELD REVERSIBLE BOOSTER.

Take first the "Highfield Automatic Reversible Booster." This set consists of three machines; a motor, a booster, and a small dynamo, the armatures of which are all coupled together, and as will be seen from the photograph, the magnets of each machine are built up on one common bed-plate.

As will be seen from the diagram (fig. 3), the booster is excited by shunt coil A, which is so designed that its influence is capable of giving a maximum boost on charge in the case of a 500–550 volt machine of 120 volts.

This shunt coil (to the booster) is connected in series with the exciter armature, thus, as shown in diagram, the connection is made from (+) terminal of the battery through this shunt coil, through the exciter armature to the (–) bus-bar.

The exciter is a small generator, capable of generating any pressure between 500 and 550 volts, and is always working is opposition to the battery; therefore, as long as the battery voltage is the same as the voltage of the exciter, the two balance each other, and no current will flow through coil A. Now to follow what takes place on a heavy discharge being demanded of the cells. The battery voltage immediately drops, it continues falling until it is below the value of the exciter voltage; immediately this occurs, the exciter sends a current through the booster coil A into the battery circuit.

In other words, if the exciter pressure is 540 volts, and the battery voltage drops to 530, then the booster voltage due to this, coil A, will be 10.

From this it will be seen immediately that the whole function of this coil A, and the exciter, is to keep the sum of the battery and booster voltages always equal to the bar voltage. This is the first feature of all boosters; before anything can be done towards

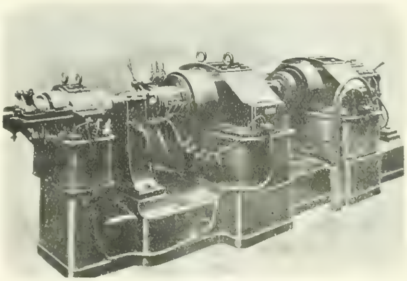


FIG. 1. HIGHFIELD REVERSIBLE BOOSTER.

assisting the generators, first of all, some arrange- [illegible] to keep its voltage always equal to bar pressure.

What is required now, is some arrangement whereby when the load is heavy, the battery voltage shall rise, and cause the battery to discharge into the line; and inversely, when the load is light, the battery voltage shall drop, and cause the battery to absorb energy from its generators. This is obtained by means of another coil wound on the booster field magnets and connected in series with the (–) main.

This coil is shown in diagram as B, and is arranged with a switch in circuit, termed a diverter, by means of which any desired amount of the main current may be shunted across, and so return to the generators without having passed through the series coil B.

This diverter switch is very essential, as by its means the amount of boost may be regulated by hand, and the tendency for the battery to charge and discharge, so varied and adjusted, according to the state of the latter, the load on the line, and the required load on the generators.

The shunt coil is provided with a cut out resistance in order that its strength may be varied by hand. The exciter is provided with a shunt field across its terminals, which also has a hand regulator in circuit. These regulators are used for altering the booster voltage at any desired moment, as when paralleling in, etc.

LANCASHIRE REVERSIBLE BOOSTER.

[illegible] this machine relies for its action on the varying strength of current in a number of coils; so in this the main principle differs from the "Highfield" booster. The result is that very fine regulation can [illegible]

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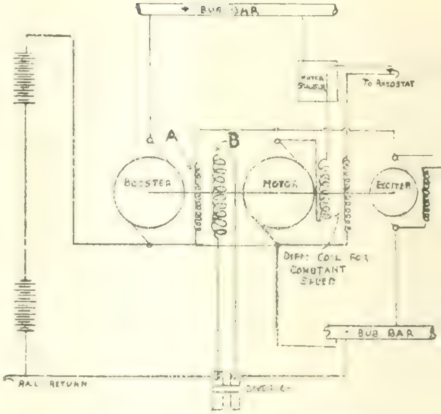


[illegible]

The Thurnbull and McLeod arrangement in the "Lancashire" consists of two machines coupled together, as shown in the photograph; one being merely the motor, the other, the booster. The magnet of the booster is built up of laminations, to assist the sudden reversals which take place in the various magnetising forces. There are four coils placed on each pole of the booster, three only of which can be seen in the photograph; the fourth being a very small coil, connected in series with the booster armature, to account for C^2R losses in the booster circuit.

As in the case of the "Highfield" machine, the first requisite is some arrangement whereby the battery and booster voltages together shall be made to always approximately equal the bus-bar voltage. This is effected by means of coil A (fig. 4) placed on the booster poles, and connected, as shown in the figure, across the armature of the booster. Coil A will always be excited by the difference between the battery and bus-bar voltage.

Coil B (fig. 4) is connected right across the bus-bar. It will immediately be seen that a very small amount of current in this shunt coil, will have a large effect on the voltage of the booster; but as this current is obviously always in the one direction, it follows that the resultant booster voltage will continually tend to make the battery either charge, or discharge, according to its direction through the field, and not both in turn. This, although being a step nearer the desired result, would make the arrangement unworkable; and so a third coil C is wound, opposing B, and connected in series with the negative [illegible] coil, there is a diverter switch in circuit, which makes it possible for any desired amount of the current to be shunted off, and return to the generators, without travelling through C. This, with the small series coil in the booster circuit, completes the arrangement, which (with the necessary switch-gear), is rendered not only workable, but highly efficient.

The "Crompton" booster is, in a number of respects, similar to the "Lancashire" machine.

There is one point, however, that has not yet been mentioned, namely, that in some tramway stations it is found desirable to make the bus-bar voltage rise and fall in proportion to the load, with a view to compensating for the drop on outgoing feeders. This cannot be done by merely installing over-compound wound generators; as under such conditions, for the voltage to rise, the load on the generators must rise also, which, of course, is undesirable.

In the "Crompton" machine, this rise and fall of the bar pressure is effected by means of an equaliser bar, connected up in such a manner, that the battery current, as well as the generator current, flows through the series winding of the generator; this causes the bus-bar volts to rise, in proportion to the total outgoing current; the battery and booster volts varying in exact proportion to the bar volts.

TRACTION PRESSURE RESULTS.

In considering the relation of the battery and booster to the rest of the plant, it will be necessary to show some actual results of running.

It is found from "Highfield" recorder sheets, that during a variation on the line of from zero to 1,800 amp. the traction pressure did not vary more than say 2 per cent., though the battery was discharging more or less, the whole time. This could have been avoided by putting in a bigger set to cope with the load, and so assist the battery; but it was found more economical to discharge the battery, using the steam set on full load, than to put a bigger set in, and run it, possibly considerably underloaded.

Sheets of the "Lancashire" booster show a somewhat similar result. In this case, however, they are of a rather smaller system. The load on the line is varying from zero to about 600 amp.; the battery breaker is set at 350 amp., the battery charge and discharge is kept somewhere about equal, and the traction pressure has a maximum fluctuation of about 2 per cent. This is, of course, ignoring very heavy fluctuations, caused by the battery breaker coming out. A fluctuation of 10 volts, on a 500, or 550 volt traction circuit may be considered by some members rather large, but it must be borne in mind that this is the maximum fluctuation, and that it occurs rarely.

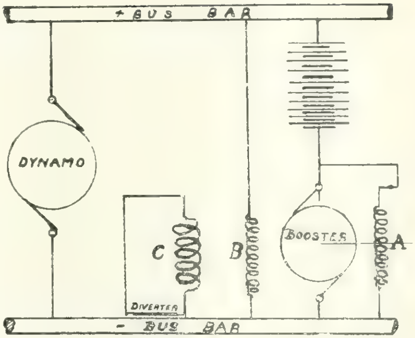


FIG. 4. "LANCASHIRE" REVERSIBLE BOOSTER.

On the other hand, the voltage under similar conditions to the above, often remains for a quarter of an hour on end, to all practical purposes constant, not varying more than ·25 per cent. Some observations taken every five seconds, extending over a period of two minutes, show that with a load on the generator of 75 kw., the maximum fluctuation was 5 per cent., the mean fluctuation 3 per cent.; the mean variation in bar pressure during this period was ·25 per cent.; the maximum variation of the load on the line was 425 amp., and the mean variation 190 amp. The system was controlled by the "Lancashire" booster.

It is not intended to imply that this result could always be obtained; but it certainly is a fact that a battery and reversible booster on traction, properly managed, maintain an excellent regulation, and a bar voltage, which for all practical purposes, is perfect.

As regards cost, although this is somewhat outside the range of this paper, it may be pointed out that by judicious employment, boosters and batteries will materially reduce the first cost of a generating plant. The cost of steam plant, roughly, may be estimated at £35 per kilowatt; whereas the cost of a battery with booster and switch boards may be estimated at £15 per kilowatt. As regards the working results of the boosters; the economy of the "Highfield" is apparent. This system, as has been shown, relies on balanced voltages for its regulation; the majority of other types rely on balanced currents.

The losses in the "Lancashire" booster, due to the various field coils opposing each other, are considerable, and the current required to drive the motor (although at times very small, owing to there being little or no load on the booster) is a continual source

[illegible]

field," by 25 per cent. Counted against this, however, must be the fact that the initial cost of a "Highfield" machine is about double that of the "Lancashire" booster.

Finally, as regards the actual running of the machines. Very little attention is required, as the boosters are so carefully designed that they adapt themselves to every variation in the load. A booster relieves the engineer of a great deal of trouble, and the steam engine from a great deal of hard usage. In return, it requires very little attention, and amply repays for its power consumption, by prolonging the life of the battery. The battery rarely gets completely run down, but is continually being charged and discharged lightly. This is an ideal mode of working a battery, and highly conducive to its prolonged life. The booster, therefore, not only exercises complete control over the battery, but also governs, and regulates, to a high state of perfection, the supply of energy to the traction system to the general, efficient, and economical working of the whole central station.

THE INSTITUTE OF CIVIL ENGINEERS.

CONSTRUCTION OF CONCRETE RAILWAY VIADUCT.

[illegible] Guilford L. Molesworth, K.C.I.E., president, in the chair, a paper on "The Construction of a Concrete Railway-Viaduct," by A. Wood-Hill, Assoc.M.Inst.E.C., and E. D. Pain, Stud.Inst.C.E., was read. The fol- [illegible]

The viaduct in question is situated at Cannington, on the Axminster and Lyme Regis Light Railway, which now connects Lyme Regis with the Yeovil and Exeter line of the London and South-Western Railway. It consists of ten elliptical arches of 50 ft. span, its total length being 600 ft., width over spandrels 16 ft., maximum height to rail-level 92 ft., and gradient 1 in 80. It affords an example of the recent application of concrete to viaduct construction and to arches of somewhat large span. With the exception of the concrete blocks in the vertical faces of the arches, the work throughout is mass concrete.

The geological strata are greensand and blue lias clay. The foundations, originally designed for a pressure of 3½ tons per square foot, were enlarged to give pressures ranging from 1½ tons to 3 tons per square foot.

The concrete used consisted of crushed flints and Portland cement, the crushing yielding sufficient grit to make the addition of sand unnecessary except in special cases. The concrete was hand-mixed, and for transporting this and other materials a cableway of 1,000 ft. span was erected across the valley, the piers being built without scaffolding.

The piers were carried up in rectangular lifts of diminishing size, instead of having a continuous batter, the lifts being 6 ft. deep. The concrete was deposited in wooden boxes of this depth, which were bolted upon the ground and hoisted into position. The mode of filling and striking the boxes, of which there are eleven, is described. The work in all the piers was advanced as far as possible at the same rate.

Two rows of corbels were built in the top lift of the piers, to support the arch-centring. This consisted of four built ribs, the centre portion of which was tied by a framework in the form of a Warren girder, supported in the middle by raking struts from the lower row of corbels. The ribs, including the latticework, were set in one piece, and four tie-bolts were placed in the span to assist the press in taking the thrust.

The faces of the arches were built in concrete blocks, of which two similar ones on opposite sides of the viaduct were set simultaneously by a rail attachment to the cableway; and by adjusting the chains attaching the blocks the latter were suspended at the angles required by their position in the arch. The blocks were keyed in advance of the mass of concrete, in order that the adhesion of the latter to the toothing of the blocks might relieve the centres of some of the weight.

Expansion joints were formed through the arches, spandrels and parapets, and are found effective in giving play for expansion and contraction, and any slight movement due to settlement. In turning the arches, the centring, although apparently light, was found to be sufficiently rigid, and the setting was facilitated by the ribs being made in one piece.

The settlement of the piers was for the most part fairly even, and being adjusted as the work proceeded, did not affect the concrete; but the settlement of the west abutment and first pier was greater than elsewhere, and crushed the crown of the first arch. Two diaphragm-walls were built in brickwork in cement in the third span, to enable it to act as an abutment, and concrete needles were built in the embankment between the first and second piers; the crushed portion of the front arch was cut out and made good in brickwork, and the parapets over this arch were completed. Particulars are given of the cost of the viaduct, and a schedule is appended of the results of tests of sample blocks made from materials used in the concrete.

The authors believe this is the first instance in which piers of a similar height have been built without scaffolding, and in which the centres of a 50-ft. arch have been designed for setting in one piece.

LEEDS ASSOCIATION OF ENGINEERS.

ENGLISH INVENTIONS AND AMERICAN ADAPTORS.

The thirty-ninth anniversary dinner was held at the Queen's Hotel, Leeds. Sir James Kitson, Bart., M.P., occupied the chair.

In proposing the toast, "Prosperity to the Association," Sir James Kitson referred to his recent visit to America, in connection with the Iron and Steel Institute.

What impressed him most during his visit there was not the invention of new processes, but the development of old ones. He had remarked the great use the Americans made of the system of moving materials by belt or by rollers, and he thought engineers in this country should more largely direct their attention to this point. He had visited the Du Quesne blast furnaces of the Carnegie Company. There were four furnaces, and in the month of October they produced a record amount of 74,600 tons of pig iron. That was only possible by these systems of conveying. He also visited the Works of Messrs. Jones and Laughlin, where steel was being produced by the Talbot process—an instance of an English invention which had received immense development in the United States. They were building four more furnaces, so as to produce from 250,000 to 300,000 tons a year by the Talbot process.

The furnace alluded to gave 5 per cent. more steel than was actually charged in metal, and that additional 5 per cent. came from the oxides from the scale, etc., which were liberally supplied from the rolling mills. He himself saw the furnace at work—he saw a charge cast, a most beautiful operation, which had the great advantage that the steel was melted by natural gas. Natural gas was, of course, a very beautiful fuel for steel melting, but it was a gradually diminishing quantity. Whereas, for instance, fourteen years ago the Americans were firing all the boilers with it, and using it in a very profuse manner, they had now begun to fire their boilers with coal, and were reserving gas for the more special processes of steel smelting, welding, and the like. And so some of their advantages were passing from them while our own fuel and opportunities still remained with us. Everywhere one went the Bessemer, the Siemens, and now the Talbot processes were being used—all the inventions of this land, which were receiving their greatest development in the United States.

SMELTING STEEL WITH FROZEN AIR.

One very interesting and new instance was introduced to them by Mr. Galey, who read a paper on his new method of freezing air. That method was really a most remarkable improvement and development of the use of the blast-furnace. For several months they had been working a furnace at Pittsburg with frozen air. The result of that had been that the burden of the Galey furnace has been increased from 2,516 tons per week to 3,129 tons per week—an increase of 620 tons per week, simply by the use of frozen air, with the same furnace and the same plant, and the saving in coke has been enormous—from 2,147 tons per week to 1,726 tons, a difference of 421 tons, or nearly 4 cwt. to the ton. It behoved foremen engineers to acquaint themselves with these new processes and developments.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.

THE GARRETT RE-HEATING FURNACE.

A paper on this subject was read by Mr. J. S. Trinham, before the Institute on December 17th. The following is a summary of the chief points of the paper:—

The author states at the outset that from tests made he recommends the altering of re-heating furnaces to the Garrett type. The Garrett grate, wherein lies the whole secret, is easily and cheaply adapted. The invention belongs to the class of gas producers, in which air is blown into a mass of coal, coke, or like fuel in a chamber to sustain partial combustion of such fuel, and to provide a producer which will prevent clogging of the ashes and refuse below the fuel bed. Briefly, the producer consists of a perforated air box, supported on a foundation built of old fire brick, and extending round the four sides of the hearth. A water pan below the ground level, 5 ft. wide by 7 ft. 3 in. long, over all, and 21 in. deep, has a seal board 5 ft. by 11 in. to prevent any escape of air, the depth of the board being regulated by the pressure in the grate. There is also a Flemish bond bridge, measuring 3 ft. from top of air box by 12 in. wide, with benders and stretchers course about. Air is led through a 2 in.

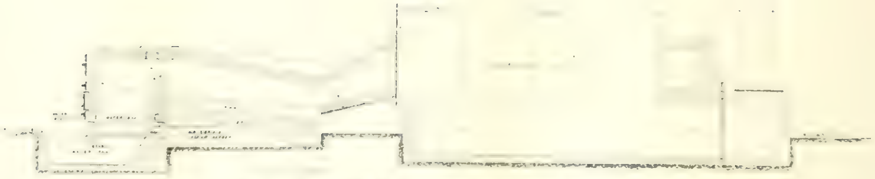


FIG. 1.—SECTIONAL ELEVATION—GARRETT FURNACE.

round hole in the top of the air box, through 5 in. by 2 in. spaces in the bridge, and takes a zig-zag course, so that it meets the flame from the grate at a high temperature. Two firing doors, 12 in. square are in front, and three bricked hinged cleaning doors at the end of the furnace; the centre cleaning door is 18 in. square, and the others 8 in. by 12 in.

Each furnace requires 4,000 cubic feet of air per minute. This is supplied by a fan capable of giving 20,000 cubic feet of air per minute against a head of [illegible] W. G. [illegible] excess air churns back. It is belt driven by a 15 h.p. reciprocating engine. The air is discharged into a 26 in. diameter sheet iron central main, and branches 12 in. diameter are led right and left to each furnace. A butterfly valve within the reach of the furnaceman regulates the blast to suit the condition of the iron in the furnace.

In lighting up the furnace, the water box is first filled with well-burnt rough ashes as far out as the seal board and up to the top of the air box. Live coal is then shovelled in through the firing doors and equally distributed over the bed of ashes; water is run into the pan, and the ashes become so thoroughly soaked that the heat from the fire above causes sufficient moisture to mix with the dry blast to prevent heavy clinker forming and clogging on the air box. The blast is now turned on, and as it passes through the perforations in the box it combines with the fuel in the ordinary manner, forming gas, which passes over

Mill.	[illegible]			Garrett Patent Furnaces.			In favour of Garrett Patent.			[illegible]
	Average Output [illegible]	[illegible] ton of [illegible] iron.	Furnace [illegible]	Average [illegible]	[illegible]	[illegible] charged.	Increased Output [illegible]	[illegible]	Reduced furnace waste.	
11" Guide	T. C. [illegible]	C. [illegible]	[illegible]	T. C. [illegible]	C. [illegible]	[illegible]	T. C. [illegible]	C. [illegible]	1·7 [illegible]	⅜in. to 1 5-16in. dia. [illegible] squares [illegible] hoop strip. ⅞in. to 2in. flats. [illegible] and H iron. Small angles and tees.
[illegible]	T. C. [illegible]	C. [illegible]	[illegible]	T. C. [illegible]	C. [illegible]	[illegible]	T. C. [illegible]	C. [illegible]	[illegible]	[illegible] dia. [illegible] squares [illegible] W. G. [illegible] hoop strip [illegible] flats. Angles, tees, and rails.

FIG. 2.—[illegible] FURNACE, COMPARED WITH THE GARRETT PATENT.

the hot air bridge into the furnace, and after performing its work there the spare gas is passed through the neck to the boiler and then up the furnace stack. As the ashes from the consumed coal accumulate above the air box, they are reduced to their correct level by removing the necessary quantity from the bottom of the water pan. There is no difficulty in doing this, as the cross-sectional area of the air box is greater at the bottom than at the top, thus allowing the free discharge of the ashes into the water pan. The cleaning doors are opened twice each shift for the purpose of removing clinker and freshening up the fire bed generally. The opening of the doors, cleaning and sealing them up again with fireclay, does not occupy more than fifteen minutes, and is done by a labourer while the heater is charging.

The table on previous page gives the results of careful observation :—

The author also makes reference to the merits of the Cannon type of boiler, in which, instead of leading the hottest of the waste gases to the boiler above the furnace, through a stack consisting of 850 to 1,000 best fire bricks, which have to be renewed every three or four months through being uselessly burned away, there is fixed a vertical boiler receiving these waste gases and raising steam.

The cost of altering an ordinary grate to the Garrett type is given as £47 12s., of which the castings cost £34 7s.

ADVANTAGES OF THE GARRETT TYPE.

The main advantages are : A more complete control of the air which is admitted into the furnace ; in the air box ; in the hot air from the hollow bridge meeting the escaping gases as they pass over into the furnace, thus aiding combustion without reducing the temperature in the furnace ; increased output and reduced coal and iron wastes ; the saving of steam through steam jets being dispensed with ; the maintenance of temperature ; the more even temperature in the furnace and boiler ; waste gases, which give more steam, and the saving of the cost of grate bars.

INSTITUTION OF ELECTRICAL ENGINEERS.

LEEDS LOCAL SECTION.

ELECTRIC DRIVING OF TEXTILE MILLS.

A paper on this subject was read on the 15th inst. by Mr. W. B. Woodhouse. The following is a brief abstract.

The reasons for the slow rate of adoption of the use of electrical machinery in textile factories in this country are the lack of accurate knowledge as to the results to be obtained from electrical driving and the absence, until recently, of a public supply of electrical energy at a reasonable price. That the advantages are existent may be realised from the extent of the adoption of electrical driving in other countries. The preparation of animal or vegetable fibres involves a very large number of operations, and, owing to the delicate structure of the fibre the amount of work done on it in each machine is small ; therefore the power required to drive the machines unloaded is a large percentage of the total required. The efficiency of mechanical transmission in textile mills varies with each mill. In a number of mills tested, the average efficiency at full load is 50 per cent., the lowest 34 per cent., and the highest 70 per cent. ; in all these cases, the loss of power in the main engine being included. These losses, serious enough at full load, are practically constant, and the efficiency rapidly decreases as the load becomes less.

VARIATIONS OF LOAD.

The author cites the case of a flax mill of the British Linen Thread Company. The mill is electrically driven and the transmission loss small. The maximum power demanded is 285 kilowatts, and the average 259 kilowatts, giving a working load factor of 91 per cent. Had the various machines been driven by mechanical transmission from one main engine a steady extra loss would have been incurred, on account of the friction of extra shafting and gearing ; assume this as only 20 per cent. of full load, then the maximum power would be raised to 342 kilowatts, and the load factor increased to 92·5 per cent. That is to say, the more inefficient the system of power transmission in a mill, the steadier is the load on the main engine, and, though the useful power required varies in every mill, yet, with mechanical driving, the variation is masked by the steady loss in transmission.

In a large cotton mill the variations of load ranged from 575 h.p. to 1,085 h.p.

Mill owners usually reckon their costs in pounds per i.h.p. per annum, and the figure is usually based on the minimum horse power indicated ; it is not possible to compare such a figure with the cost of electrically driving the same mill without knowing the electrical or brake horse power taken to drive each machine, or group of machines, and the working load factor of the machines.

A particularly irregular load is met with in the case of self-acting mules.

Where looms are driven in large groups the load is fairly constant, despite the frequent starting and stopping of individual looms, due to the large amount of shafting involved, and the small power taken by each loom. In an "electrical" mill, however, a recording watt meter will show the variations, and, more particularly, the tendency of the workers to start late and finish early.

The milling or fulling of woollen cloths is a process in which the power required varies from piece to piece, depending on the amount of milling required; the working load factor is very low. An actual record of a day's work of milling and washing machines shows that the working load factor is only 63 per cent. Carding machines show a fairly steady load during the time of running.

POLYPHASE MOTOR TO BE PREFERRED.

The advantages attendant on electrical driving are only partly gained if electrical transmission is adopted in the mill and the main engine or engines retained.

The effect of electrical driving on the general arrangement of a mill is to allow the various machines to be arranged in the natural order of the processes without reference to the position or direction of shafting. The subdivision of the driving accompanying the use of motors may be carried to its full extent, and a motor provided for each machine, doing away thereby with all line shafting. Extreme subdivision is, however, even in the driving of silk looms, very rarely advisable, on account of first cost, and group driving must be nearly always adopted. In arranging such driving a considerable saving on the cost of equipment can be effected by increasing the speed of the line shafts, and thereby reducing the size of shafts, pulleys, and hangers. A standard diameter of shaft may often be adopted throughout.

Certain machines have their driving shafts running at a sufficiently high speed to be direct coupled to a motor; doubtless, as electrical driving spreads, this will be possible in a greater number of cases.

This necessity of constant speed points clearly to the use of polyphase motors in preference to direct current machines. The advantages of squirrel-cage motors are many; the constancy of speed, the simplicity due to the absence of commutators and sliding contacts, their low cost, and the lessened fire risk due to the absence of exposed live metal, are all points in their favour.

Multi-voltage direct current systems with shunt motors, have much to recommend them in the case of isolated plants, but excellent results have been obtained by the use of a single supply voltage, and motors with double-wound armatures and two commutators. In the latter case a high efficiency is obtained over a wide range of speed.

CENTRIFUGAL HYDRO EXTRACTORS.

The steam-driven centrifugal machine is exceedingly wasteful and "messy"; the belt or rope driven machine involves a considerable amount of gear in the neighbourhood of the basket, and is very severe on the belts; the direct coupled electrically driven machine is compact, simple, and reliable, and can be placed anywhere. Either series, direct current, or induction motors may be used for this work; the induction motor has an important advantage in that it can never "run away." In practice the motor is completely enclosed, and flexibly supported beneath the basket. The time taken to accelerate depends on the maximum torque of the motor at various speeds. Hence, if a squirrel-cage motor is adopted, it should be built with a high resistance rotor, so that the current may be kept down during acceleration. The time taken to accelerate is then practically constant, and the machine needs no attention beyond switching on the motor, which runs up to speed and stays there until switched off.

The table below gives the power required for standard makers of machines.

POWER REQUIRED TO DRIVE CENTRIFUGALS.

BELT COUPLED AND WESTON'S TYPE.

Diam. of Basket.	[illegible]	Rev. per min.	Time to Accelerate.	Watts Starting.	Watts Running.
24	[illegible]	1,500	0.75	2,530	[illegible]
30	[illegible]	1,200	1.0	[illegible]	[illegible]
36	1.25	1,000	1.5	[illegible]	1,370
48	[illegible]	750	2.5	[illegible]	[illegible]

[illegible] AND [illegible] TYPE.

Diam. of Basket	Watts. Starting.	Watts. Running.	Time to Accelerate.	Max. Speed
[illegible]	[illegible]	2,700	1.5	[illegible]
[illegible]	5,800	2,000	[illegible]	1,000
42	[illegible]	3,200	1.5	[illegible]
48	[illegible]	3,600	[illegible]	[illegible]
54	8,400	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	5,000	1.5	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	600

INSTITUTION OF CIVIL ENGINEERS.

YORKSHIRE STUDENTS' ASSOCIATION.

The third ordinary meeting of the above association was held in the Law Institute, Leeds, the president, Mr. Ewing Matheson, M.Inst.C.E., in the chair. A paper was read by Mr. H. J. Rudgard, A.M.Inst.C.E., of the North Eastern Railway, York, the subject being "Notes on the Construction and Erection of Steelwork."

Mr. Rudgard pointed out that the main types of girders and roofs likely to be required in this country are now more or less standardised, but that there is great scope for attention to details, which can effect a great saving in first cost and maintenance.

The developments made in the rolling of joists and channels, and the machinery for cutting them, enable a considerable reduction to be made in weight and labour, over sections built up of plates and angles.

Smith's work is always expensive, and it is best to eliminate it as far as possible, especially avoiding complicated joggles and welded up angle frames.

The designer should endeavour to bring the work of construction within the scope of the shearing, planing, and drilling machines as far as possible.

The bearing, usually adopted in small bridges, namely, a bearing plate riveted to underside of girders with sheets of lead or felt interposed between it and the impost stone, is not altogether satisfactory, and a better method is to use a cast iron rocker bearing on a cast iron plate lewised to the import stone. For larger bridges pin bearings are used, and for all bridges of 70 ft. span or over, one end should be carried on an expansion bearing. It is most important that all steelwork be thoroughly cleaned before assembling and painting, as corrosion, once started, proceeds very rapidly, even under the paint. Paraffin oil has been used with good results for dipping steelwork, and has the advantage of being non-sticky, so that dust does not adhere as with the ordinary oil.

Ordinary erection does not give much trouble, but difficulties arise when bridges have to be renewed or replaced in a limited time so as to interfere with traffic as little as possible. An interesting description of a bridge replacement of this kind was given, in which, on one Sunday, 115 tons of steelwork had to be lifted into or out of the structure.

Special lifting brackets provided on the ends of main girders geatly facilitate this work, and a light temporary traveller running on top of the main girders is also a great convenience for handling cross girders and flooring.

The various points were illustrated by a series of drawings and diagrams.

A long and interesting discussion followed in which the president, Messrs. W. J. Cudworth, S. R. Kay, W. D. Rudgard, H. P. Miles, Clayton, Forbes, Terry, and Pullon took part.

A hearty vote of thanks to Mr. Rudgard brought the meeting to a close.

The election is announced of Mr. Philip Watts, F.R.S., director of naval construction, as a vice-president of the Junior Institution of Engineers.

On the invitation of the chairman, Mr. Samuel Cutler, jun., M.I.Mech.E., a large number of the members of the Junior Institution of Engineers, visited the International Gas Exhibition at Earl's Court.

The Christmas lectures at the Royal Institution are being delivered by Mr. Henry Cunynghame. The subject is "Ancient and Modern Methods of Measuring Time," and there are six lectures, two of which have already been delivered, the third of which is being delivered to-morrow, while the remaining three lectures are fixed for next week. The first lecture dealt with the methods of measuring time known to the ancients. The second address was devoted to the "Discoveries of Galileo."

The annual dinner of the West of Scotland Iron and Steel Institute was held at Glasgow last week. The president, Mr. Andrew Lamberton, occupied the chair, and there were about 250 members and visitors present. The toast of the "The City of Glasgow" was proposed by Professor A. Barr, and responded to by the Lord Provost (Sir John Ure Primrose, Bart.). The toast of "The West of Scotland Iron and Steel Institute" was proposed by Mr. Bennett H. Brough, and acknowledged by the president. The toast of "Kindred Institutes" was replied to by Mr. R. T. Moore, president of the Mining Institute of Scotland.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

Last Day.

Belgium. [illegible] "College Echevinal," Saint Trond ... Jan. 1

Sweden. [illegible] various diameters, for Tulea Waterworks Committee. Particulars, Commercial Intelligence Branch, Board of Trade, Basinghall Street. Tenders to Com- [illegible] ... Jan. [illegible]

Chippenham. — Building of high level service reservoir to hold 100 000 gallons new pumping station, and dry well, etc. Particulars from the Engineer, Mr. A. E. Adams, High Street, Chippenham ... Jan. [illegible]

Cricklade.—Construction and maintenance of works for supplying Cricklade with water. Mr. H. Bevir, Clerk, Cricklade and Wootton Bassett District Rural [illegible] ... Jan. [illegible]

Great Western Railway. Supply and delivery of materials in connection with the electrical equipment of the Hammersmith and City Railway. Mr. G. K. Mills, Secretary, Paddington Station, London ... Jan. [illegible]

Tottenham, London.—Provision and laying of 30-in. cast-iron pumping main for the Tottenham and Wood Green Joint Drainage Committee. Mr. Edward Crowne, Clerk, Tottenham... ... ... Jan. 3

East Indian Railway.—Supply and delivery of steel material (plates, bars, joists, etc.). Mr. C. W. Young, Secretary, [illegible] ... Jan. [illegible]

West Hartlepool. Supplying hot water [illegible] ... Jan. [illegible]

Erith. Four contracts in connection with the Electric Tramways. Particulars of Messrs. Hawtayne and Zeden, 6, Queen Street Place, London, E.C. Tenders to Mr. C. H. Fry, Clerk ... ... Jan. 9

Glasgow.—Supply of steel work for the re- [illegible] spans of Esk Viaduct, for the Caledonian Railway Company. Mr. J. Blackburn, Secretary, Buchanan Street, Glasgow ... Jan. 9

Stockport.—Supply and delivery of about [illegible] fishplates, and 1,480 anchor joints for the Corporation. Mr. Robert Hyde, Town [illegible] ... Jan. [illegible]

Newton Abbot. — Construction of a masonry reservoir, to contain 85,000 gallons, and providing and laying 900 ft. of 4-in cast iron mains. Mr. Samuel Segar, Engineer, Union Street, Newton Abbot ... Jan. [illegible]

Belfast.—Supply and erection at new infectious diseases hospital, of boilers and electric light installations, including engines, dynamos, etc. Mr. Samuel Black, Town Clerk ... ... Jan. 12

Bettws-y-coed.—Construction of waterworks extensions, about seven miles, and an embankment. Mr. E. R. Owen, Union Offices, Llanwrst .. .. Jan. 12

Spain.—Supply of revolving platforms (Contract 1), steel rails (Contract 2), in connection with the improvements at the Port of Valencia. Particulars of the Commercial Intelligence Branch, Board of Trade, 73, Basinghall Street. Tenders to Port Ad- [illegible] ... Jan. 16 & Jan. [illegible]

London. Construction, supply, and erection for the South London Electric Supply Corporation at their works, of one 750 kw. steam alternator, etc. Secretary, Bengeworth Road, Loughborough Junction ... Jan. 16

Dover.—Construction of about 1¼ miles of double line of light railway to River, including the supplying and laying of steel girder rails, etc. Borough Engineer, [illegible] ... Jan. [illegible]

Ripon. —Retubing condensers for the Corporation. The Gas Manager, Ripon ... Jan. 18

Kidderminster. — Erection of engine house, boiler house, and provision, laying and jointing of 800 yds. 10 in. cast-iron main, in connection with water supply. Engineers Messrs. Wilcox and Raikes, 63, Temple Row, Birmingham ... ... Jan. 20

Port Elizabeth. Supply of materials in connection with Corporation Electricity Supply Works. Section A: Boiler-house plant; Section B: Engine-room plant; Section C: Electricity supply mains; Section D: Accumulators and boosters; Section E: Switchboards and instruments; Section F: Cranes; Section G: Public Lighting; Section H: Meters; [illegible] Davis and Soper, Agents, 54, St. Mary Axe, London, E.C. ... ... Jan. 26

Edinburgh.—Supply of gas plant and appliances, including gas exhausters and engines, water-tube condensers, Pelouze and Audonin condensers, etc., for Edinburgh and Leith Corporations. Mr. James McG. Jack, 25, Waterloo Place, Edinburgh Jan. 30

Last Day.

Caen (France).—Tenders for concession of a tramway from Ryes to Caen via Creully for goods and passengers. Particulars from the Prefect of Calvedos, Caen ... ... Feb. 2

Dublin. — Extension of pier in Downies Bay, County Donegal, and other works. Office of Public Works, Dublin Feb. 11

COMING CONTRACTS.

South Shields. -The Corporation is about to undertake tramway construction work.

Burslem.—The Town Council have received sanction to the following loans: refuse destructor, £9.984 and electric lighting, £21,000.

Woolwich.—The Borough Council have resolved to apply to the L.C.C. for permission to borrow two sums of £7,500 each for the extension of electricity mains to Eltham and Shooter's Hill.

Erith.—An inquiry has been held into the application of the Council for sanction to borrow the further sum of £20,000 for the purposes of the electricity undertaking.

Bernese Oberland.—Steps are being taken to raise £3,200,000 for the construction of a line of railway under the Bernese Oberland, which is to join the Simplon tunnel line.

West Hartlepool.—An inquiry has been held into the application for sanction to borrow £22,000 for purposes of electric lighting, and sewage works, £1,030.

Warwick.—The engineers have been instructed to obtain tenders for carrying out the first portion of a waterworks scheme, which embraces the sinking of a well and the erection of pumping station.

Croydon.—The Corporation are seeking powers to raise £9.480 for duplicating water mains.

Widnes.—The Corporation is proposing to spend a sum of £54,000 on gasworks extensions.

Thames.—The Thames Harbour Commissioners are seeking powers to construct a dam, with locks, weirs, sluices, etc. The work is to take six years, and power is being asked to raise a sum of £5,000,000.

CONTRACTS CLOSED.

Great Yarmouth.—The Corporation have accepted the tender of Jacobs Bros. and Co. for tramway rails at £4,095

Glasgow.—Messrs. A. and J. Inglis have contracted to fit on board the Khedive's yacht *Mahroussa* turbine engines of the Parsons type.

Chepstow.—Edward Finch and Co., Ltd., are just completing an important contract in the shape of a caisson for closing the entrance to the large new graving dock in course of construction at Colombo.

Shanghai-Nanking Railway.—John H. Wilson and Co., Ltd., of Liverpool, have been awarded a contract for two powerful permanent way breakdown cranes

Great Western Railway.—Kerr, Stuart and Co. have secured a contract for two steam motor coaches on the "Kerr Stuart" system with transverse locomotive boiler. The same firm have a second order for two coaches of the same type as those ordered by the Taff Vale Railway.

Billericay.—The Billericay Rural District Council have instructed Messrs. Merryweather and Sons to prepare a water supply scheme for Billericay and a number of surrounding villages.

Malta. –The Lancashire Dynamo and Motor Company, Ltd., has received an order from the Admiralty for the whole of the electrical equipment for Malta dockyard, including boilers, engines, dynamos, motor generators, and motors, in accordance with the specification of Messrs. Preece and Cardew.

Llandudno.—The Urban District Council have accepted the tender of the Hart Accumulator Company, to supply 256 standard lighting type cells.

Barrow-in-Furness.—Vickers Son and Maxim, Ltd., have given orders to Horace P. Marshall and Co., for fifty pneumatic tools for the Barrow shipyard.

Metropolitan Railway.—The whole of the cables used for current distribution on the Metropolitan Railway on which electrically-propelled trains are now running, have been supplied by the British Insulated and Helsby Cables, Ltd., of Prescot, Lancashire.

APPOINTMENTS VACANT.

Last Day.

Hanley.—Borough electrical engineer. Salary, £300 rising to £350. Applications to Mr. Arthur Challinor, Town Clerk ... Jan. 10

Sheffield.—Superintendent of gasworks under Sheffield United Gasworks Company. Commencing salary, £300. Applications to Mr. Hanbury Thomas, general manager, Commercial Street, Sheffield ... Jan. 12

APPOINTMENTS FILLED.

Bridlington.— Mr. A. J. Beckett, formerly assistant electrical engineer at York, has been appointed electrical engineer at Bridlington at a salary of £220 a year, rising to £250. An assistant is to be appointed at a salary of £100.

Christchurch, N.Z.—Mr. Percival Herbert Powell, of Stafford, has been appointed lecturer and demonstrator in electrical engineering at Canterbury College, Christchurch, New Zealand.

Midland Railway.—Mr. H. Evans, of the Glasgow and South-Western Railway, has been appointed by the Midland Railway Company, to succeed Mr. W. E. Adie, as goods' manager as from March 1st next.

Sierra Leone.—Mr. W. E. May has been appointed chief engineer of the railways under the government of Sierra Leone. Mr. May, who has been in Africa for several years, was at one time connected with the Taff Vale Railway Company.

Borneo.—Mr. H. F. May has been appointed chief engineer of the mines and collieries in Borneo of the Rajah of Sarawak. Mr. May has latterly been connected with the Roudny Gold Mines at Zwestow, Bohemia.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the Industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows:—
Consols, January 5th. General Settlements, December 30th, January 13th, 27th. Bank Rate, April 21st, 3 per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES

Present [illegible]	[illegible]	[illegible] dend	[illegible]	[illegible]	[illegible]
[illegible] 7[illegible]	[illegible]	[illegible]	A[illegible] O[illegible] [illegible] Engineering, Ltd.	3	2[illegible] — [illegible]
10,000	5	3/-	Do. Cum. Pref. [illegible] per cent	5	1[illegible] — [illegible]
80,000	Stk	4[illegible]	Do. Mort. Deb. [illegible]	100	98 —100
3,210,000	1	[illegible]	Armstrong, Sir W. G., Whitworth and Co., Ltd.	1	[illegible]
76,970	[illegible]	2	Do. 4% Cum. Pref..	[illegible]	[illegible]
1,[illegible]	100	4	Do. 4% 1st Mort. Debs. Red	100	102 —104
£100,000	100	4[illegible]	Avel[illegible] and Porter, Ltd., 4[illegible] 1st Mt. Debs. Red.	100	97 —100
[illegible]	1	1/7	Babcock and Wilcox, Ltd., Ord. ..	1	3[illegible] — [illegible]
100,000	1	7[illegible]	Do. .. [illegible] Cum. Pref.	1	1[illegible] — [illegible]
20,000	[illegible]	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	[illegible]
250,000	1	[illegible]	Baldwins, Ltd., 5½% Cum. Pref.	1	1 — 1[illegible]
£250,000	Stk	4[illegible]	Do. 1st Mt. 4[illegible] Deb. Stk. Red.	100	101 —103
150,000	1[illegible]	2/[illegible]	Barrow Hæmatite Steel Co., Ld., O	[illegible]	[illegible] 1
50,000	1[illegible]	[illegible]	Do. do. Cum 2nd. Pref.	1[illegible]	[illegible]
[illegible]	[illegible]	2/6	Ba[illegible], J[illegible] and Ba[illegible], Ltd. [illegible] Pref. Shares	[illegible]	1[illegible] — [illegible]
£500,000	100		Bea[illegible] W[illegible], Ltd. 4½ 1st Mt. Debs., Red., Scrip 50 .. pd		100 — 10[illegible]
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11 — [illegible]
£366,600	Stk	4	Do 4% Deb. Stock, Red	100	100 — 10[illegible]
149,850	1	6d.	Bengal Iron and Steel Ord.	1	1 — 1[illegible]
200,000	1	1	Beyer, Peacock and Co., Ltd., Ord.	1	[illegible]
300,000	1	[illegible]	Do. [illegible] Cum. Pref.	1	[illegible]
£300,000	Stk	1½	Do. 4[illegible] Red. Deb. Stock	100	[illegible]
1,629,760	1	6d.	B[illegible] [illegible], Ltd., O[illegible]	1	[illegible] — 1
1,860,900	1	[illegible]	Do. N[illegible]	1[illegible]	[illegible]
1,160,000	1	[illegible]	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	1	1[illegible]
590,000	1	[illegible]	Do. Ord., Nos. 1,160,001-1,750,000		1[illegible]
74,000	10	[illegible]	Do. Cum. Pref.	10	11 — 11½
154,500	[illegible]	[illegible]	Cammell, Laird & Co., Ltd., Ord.		7[illegible]
232,500	5	2/[illegible]	Do. 6% Cum. Pref. ..		[illegible]
450,000	1	[illegible]	Clayton & Shuttleworth, Ltd., Ord.		[illegible]
70,000	[illegible]	2/6	Do. 5% Cum. Pref		[illegible]
£250,000	Stk	4%	Do 4% 1st Mort Db. Stk. Red	100	100 -102
100,000	10	[illegible]	Consett Iron Co., Ltd., Ord..	7½	[illegible]
75,000	1	[illegible]	Delta Metal, Ltd. Shares	1	1[illegible]
[illegible]	1	[illegible]	[illegible]		[illegible]
£400,000	Stk	[illegible]	[illegible] Deb. Stk.	100	[illegible]
£250,000	Stk		[illegible] Mort. Deb. Stk. Red		[illegible]
200,000		3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..		[illegible]
250,000	1	[illegible]	Dunlop (James) & Co., Ltd., Ord.	1	[illegible]
300,000	1	7½[illegible]	Do. 6% Cum. Pref.	1	[illegible]
4,721	13	12/-	Ebbw Vale Steel, Iron & Coal Co., [illegible]	[illegible]	[illegible]
69,754	13	[illegible]	Do. do. do.	[illegible]	[illegible]
[illegible]	[illegible]		Elliott's Metal, Ltd. ..		1[illegible]
[illegible]	10		Do. Cum. Pref. 5%		[illegible]
[illegible]	Stk		[illegible]	1[illegible]	[illegible]
[illegible]	10		[illegible] Ltd., 6% Cum. Pref.		[illegible]
[illegible]	Stk		[illegible]		[illegible]
120,000			[illegible]		[illegible]
[illegible]	3		Do. 7½% Cum. Pref.		[illegible]
965,000	1	[illegible]	Guest, Keen & Nettlefolds, Ltd. Ord.		2[illegible]
[illegible]			[illegible] Pref.		[illegible]
[illegible]	Stk	4	Do. [illegible] Mort. Deb. Stk.		[illegible]
[illegible]			Gwynnes, Ltd., 5% Cum. Pref.		[illegible]
250,000	1	[illegible]	Hadfield's Steel F'dry Co., Ld., Ord		[illegible]
[illegible]	10		Do. [illegible]		[illegible] — 1
[illegible]	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref...		[illegible]
[illegible]		3/[illegible]	Harvey United Steel Co., Ltd. ..		[illegible]
[illegible]	5		Head, Wrightson & Co., Ltd.		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	5	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present [illegible]	[illegible]	[illegible]	[illegible]	Paid up	Closing Prices
37,500	10	20	Kynoch, Ltd.	10	17[illegible] — 18[illegible]
49,537	10	[illegible]	Do. Cum. Pref. [illegible]	10	10[illegible] — 10[illegible]
300,000	[illegible]	4½d	Lambert Bros., Ltd., Ord.	1	[illegible] — [illegible]
[illegible]0,000	[illegible]	[illegible]	Do. [illegible] Cum. Pref.	5	4 — 4½
40,000	[illegible]	2/11½	Leeds Forge Co., 7% Cum. Pref. ..	8	3[illegible] — 4½
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1[illegible] — 1[illegible]
£300,000	Stk	4[illegible]	Do. 4½ 1st Mt. Deb. Stk. Red	100	110 —112
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11 — 11½
210,000	1	[illegible]	M[illegible] B[illegible] Ltd., Ord.	1	[illegible]
75,000	1	6½d.	Do. 5½% Cum. Pref.	1	[illegible]
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	96 — 99
21,943	[illegible]	2/6	M[illegible] Metal Ltd	5	4[illegible] — [illegible]
14,248	5		Do. Pref	5	4[illegible] — [illegible]
5,000	6[illegible]	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	73 — 7[illegible]
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	11[illegible] — 12
80,000	[illegible]	—	North-Eastern Steel Co., Ltd., Ord.	5	
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	92 — 95
122,000	[illegible]	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3[illegible] — 4½
50,000	[illegible]		Do. [illegible] Cum. Pref. "A"	5	5[illegible] — [illegible]
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10	9 — 9[illegible]
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	97 — 100
20,000			P[illegible] B[illegible] & Co., Ltd., 6% C. P.	5	4[illegible] — 5
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	[illegible]
1[illegible]	[illegible]	2/-	Rhymney Iron Co., Ltd.	5	1[illegible] — 1[illegible]
7[illegible]			Do. New	5	1½ — 1½
£330,000		5%	Do. 5% Mort. Deb., Red. ..	100	101 — 103
350,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf.	1	[illegible]
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	96 — 98
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	9[illegible] — 9[illegible]
275,000	1	6d.	Scott (Walter), Ltd., Ord.	1	[illegible]
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	1 — 1½
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk	100	95 — 9[illegible]
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	92 — [illegible]
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	94 — [illegible]
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	[illegible]
300,000	1	—	Do. 6% Cum. Pref...	1	[illegible]
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	[illegible]
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	1[illegible] — 1[illegible]
25,000	10	[illegible]	Do. [illegible] Cum. Pref.	10	3[illegible] — 4
£250,000	Stk	[illegible]	Do. [illegible] Perp. Deb. Stock	100	77 — 81
85,000	1[illegible]	[illegible]	[illegible] Ltd., Ord.	10	17 — 17½
55,000	10	[illegible]	Do. [illegible] Pref.	10	14 — 14½
[illegible]	1	1/6½d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	[illegible] 1
[illegible]	1	6d.	Do. 5% Cum. Pref.	1	[illegible] 1
£240,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	98 — 101
300,000	1	6d.	Thames Iron Works, Shipbuilding & [illegible] Co., Ltd. [illegible]	1	[illegible]
£[illegible]	100	[illegible]	Do. [illegible] 1st Mort. Deb.	100	67 — 7[illegible]
[illegible]	1	[illegible]	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	1[illegible] — 1[illegible]
10,000	[illegible]		[illegible]	10	[illegible] — 10[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Corp. [illegible]	[illegible]	2[illegible] — [illegible]
[illegible]	[illegible]	[illegible]	Do. 7% Cum. Pref. Stock	$100	91½ — 9[illegible]
[illegible]	[illegible]	[illegible]	Do. 10-60yr. 5% Skg. Fd. G. Bds	$1000	93 — [illegible]
3,350,000	1		[illegible] Ma[illegible]	1	[illegible] — [illegible]
750,000	[illegible]		Do. 5% Non-Cum. Pref. ..	1	1[illegible] — 1½
£750,000	[illegible]		Do. 5% Non-Cum. Pref. Stock.	100	111 — 114
£1,250,000	[illegible]	[illegible]	Do. [illegible] Mort. Deb. Stk. [illegible]	100	10[illegible] — 10[illegible]
£1,000,000	[illegible]	4[illegible]	Do. [illegible] Mort. Deb. [illegible]	100	10[illegible] — 10[illegible]
225,000			[illegible]		
			[illegible] Pref. [illegible]	1	[illegible]
500,000	1	[illegible]	[illegible] Ord.	1	[illegible] 1
£300,000	Stk	[illegible]	[illegible] Perpetual Deb. [illegible]	100	[illegible]
7[illegible]			[illegible]		
			[illegible]	[illegible]	[illegible]
[illegible]	Stk	[illegible]	[illegible]	100	[illegible]
[illegible]			W[illegible] Or.	1	1 — [illegible]
[illegible]			Do. [illegible] Pref.		[illegible]
[illegible]	Stk		Do. [illegible]	100	73 — 75
[illegible]	Stk	[illegible]	Yorkshire Iron & Coal Co., Ltd., [illegible] Red.	100	[illegible]

[illegible]

—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	[illegible]
120,000	1	9½d.	Bell's Asbestos Co., Ltd.	1	[illegible]
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord.	5	5¼ 5¾
100,000	5	3/-	Do. 6% Cum. Pref.	5	5¼ 5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	102 —105
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	100 —102
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 6% Pref. ..	5	2⅝ 2⅞
£616,353	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	88 — 90
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	[illegible]
150,000	2	2/4½	Do. 6% Pref.	2	1⅜ 1⅝
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	93 — 96
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	69 — 73
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	9 10
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 - 5¼
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb Stk. Red.	100	104 -106
85,000	3	1/6	Crompton & Co., Ltd...	3	1¾— 2
£100,000	-	5%	Do. 5% 1st Mort. Reg. Debs.	100	94 — 99
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	7½ - 8
61,000	5	3/-	Do. 6% Cum. Pref.	5	5½ 5¾
£300,000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	107 —109
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1¼ 1⅜*
£233,334	Stk	4%	Do. 1st Mort. 4% Iree. Deb. Stk.	100	105 -108*
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	[illegible]
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1 — 1½
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	78 — 83
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	79 - 84
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛ - 1¼
31,390	2	2/9½	Do. 7% Cumulative Pref. ..	2	2¼ - 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	98 —100
10,248	10	7/6	Evered and Co., Ltd...	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
£25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	10¼— 10¾
35,000	5	2/3	Do. 4½% Cum. Pref.	5	5⅛— 5⅜
£50,000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	110 —112
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	15 — 16
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 —102
7,500	10		Parker, Thos., Ltd.	10	6½— 7
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	38 — 40
£150,000	100	4%	Do. 4% Deb. Bonds	100	103 —105

III.—ELECTRIC TRACTION.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	7⅛ 7⅜
260,007	5	2/6	Do. 5% Cum Pf.	5	5 7/16 - 5 9/16
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	143 - 146
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	11 11½
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	98 101
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	95 —100
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	⅝— ¾
59,394	1	—	Do. 5% Cum. Pf. ..	1	1 1¼
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord.	5	1½ 2
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾ 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	96 —100
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	100 —103
		5%	Pref. Ord. Stock	100	100 —103
7,500	10	5/-	Do. 5% Cum. Perp. Pf. ..	10	10¼ 10¾
£242,800	40	4½	Do. 4½% 1st Mort. Debs. ..	40	102 -104%
£220,000	100	4½%	Do. 4½% Vancouver Power Db.	100	98 —101
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9¾— 10¼
156,487	10	6/-	Do. 6% Cum. Pref.	10	10¾ 11¼
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk.	100	117 —119
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	95 97
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3½ 3¾
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	[illegible]
27,000	5	3/-	Do. "B" do.	5	[illegible]
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	95 99

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up.	Closing Prices
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	97 —100
102,268	5	3/-	Calcutta Tramways Co., Ltd.	5	7⅞ 8⅛
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	108 110
480,000	1	1/-	Cape Electric Tramways, Ltd.	1	1⅜ 1½
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5% Cum. Pref.	5	4⅞ 5⅛
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	98 102
155,000	5	4/-	City of Buenos Ayres Trams. Co., Ld.	5	10¼ 10½
£116,000	Stk	6%	Do. Per. 6% Deb. Stk...	100	140 -145
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 —104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 14
59,987	10	6/-	Do. 6% Pref... ..	10	15 - 16
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3½— 4
£150,000	Stk	4%	Do. 4% Deb. Stock..	100	90 93
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10⅝— 10⅞
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	103 —105
£50,000	Stk	—	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red.	100	103½ -105
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	½
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	¾ 1
£350,000	Stk	13/7	Do. 4½% Deb. Stock, Red.	100	104 106
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	1— 1½
110,923	8	2/9½	North Metropolitan Tramways Co..	8	4¼ - 4¾
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 95
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.), 5% 1st Mort. Deb. Stock, Red..	100	103 —106
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8 — 9
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8½— 9½
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	99 102

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up.	Closing Prices
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12 — 13
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½ - 10
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 — 12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	104 —106
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼— 5¾
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 —104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10½— 11
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10¼— 10¾
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord.	5	7⅝ — 8⅛
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	104 — 107
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8¼ — 8¾
10,000	5	—	Do. do. Ord.	5	8 — 8½
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	[illegible] — 5 7/16
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	101 —103*
40,000	5	2/3	Do. do. "City Undertaking" 4½% Cum. Pref ..	5	4⅞— 5 1/16
40,000	5	2/3	Do. do. do. (1903) .	5	4⅝ 5 1/16
44,136	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6⅝ - 7
£150,000	Stk	4½%	Do. do. 4½%, Deb. Stk., Red	100	109 111
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	10¾— 11¼
40,000	10	6/-	Do. 6% Cum. Pref.	10	13½ — 14
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	123 —127
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	103 —105
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9 — 9½
30,000	10	6/-	Do. 6% Cum. Pref.	10	12 — 12½
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	107 —110
£250,000	—	4½%	Do. 4½% 2nd Deb. Stk., Prv. Crts. all paid, Red	100	101 —103
70,000	5	4/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6⅛ — 6⅝
70,000	5	3/-	Do. 6% Cum. Pref. .	5	6 — 6¼
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Red.	100	107 —109
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	88 — 93
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O.	5	5½ — 6
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	102 —105
15,000	10		Havana Electricity Co., Ltd...	10	9½ -10½
13,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7½ 8
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100 102
150,000	1	-	Kalgoorlie Electric Power & Lighting Corp., Ltd., 6% Cum. Pref.	1	[illegible]
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12½— 13

Stocks and Shares marked * are quoted ex-dividend

ELECTRIC LIGHTING AND POWER—Contd.

				up	
			Notting Hill Electric Lighting Co., Ltd., [illegible] Deb. Stock, Red.	[illegible]	102 —104
111,000	3	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	10	[illegible]
220,000	Stk	[illegible]	[illegible]	[illegible]	[illegible]
250,000	Stk	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	100	[illegible]
10,852	10	[illegible]	[illegible]	10	[illegible]
£[illegible],000	100	4%	Do. 4%, 1st Mort. Debs. ..	100	[illegible]
£50,000	Stk	[illegible]	[illegible]	[illegible]	99 —101
£84,700	100	[illegible]	[illegible]	[illegible]	[illegible]
20,000	5	[illegible]	[illegible]	[illegible]	[illegible]
£150,000	Stk	[illegible]	[illegible]	[illegible]	[illegible]
12,000	5	[illegible]	[illegible]	[illegible]	[illegible]
£50,000	Stk	[illegible]	Do. [illegible]	[illegible]	83 — 87
65,000	5	[illegible]	[illegible]	[illegible]	[illegible]
100,000	[illegible]	[illegible]	[illegible] & Power Co., Ltd. Ord.	1	[illegible]
[illegible]	1	[illegible]	Do. 7%, Cum. Pref.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Urban Electric Supply Co., Ltd., O.	5	[illegible]
[illegible]	Stk	[illegible]	Do. 4½%, 1st Mort.Deb.Stk Red	100	[illegible]
[illegible]	[illegible]	[illegible]	Westminster Elec. Supply Corp.	[illegible]	[illegible]
28,151	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

V.—TELEGRAPH & TELEPHONE COMPANIES.

£34,800	100	[illegible]	African Direct Tel. Co., Ld., 4% Mt. [illegible]	[illegible]	[illegible]
25,000	10	[illegible]	[illegible]	[illegible]	[illegible]
£763,580	Stk	[illegible]	[illegible]	[illegible]	[illegible]
£3,118,210	Stk	25/-	Do. 6%, Preferred Ordinary	100	103 —104
£3,118,210	Stk	[illegible]	[illegible]	[illegible]	[illegible]
44,000	5	[illegible]	[illegible]	[illegible]	[illegible]
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord	[illegible]	[illegible]
6,000	10	10/-	Do. 10%, Preference ..	[illegible]	[illegible]
6,000	[illegible]	2/	Direct Spanish Telegraph Co., Ord 10%, Cum. Preference	[illegible]	[illegible]
£30,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Direct U.S. Cable Co., Ltd. ..	[illegible]	[illegible]
£55,800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	2/6	Eastern Extension, Australasia and [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	135 —138
[illegible]	[illegible]	5/	Great Northern Telegraph Co.,Ltd..	[illegible]	[illegible]
£58,700	100	[illegible]	[illegible]	[illegible]	[illegible]
17,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] 6%, Cum. 1st Pref.	10	[illegible]
[illegible]	[illegible]	[illegible]	do. 2nd do.	10	[illegible]
[illegible]	[illegible]	[illegible]	Do. [illegible] do.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. [illegible] be paid	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Deb. Red.	100	98 —100
[illegible]	[illegible]	2/6	Do. 5%, Cum. Pref.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	100	105½—107½
[illegible]	[illegible]	4/-	W. African Telegraph Co., Ltd ..	[illegible]	[illegible]

TELEGRAPHS AND TELEPHONES—Contd.

				Paid	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
150,000	[illegible]	[illegible]	[illegible]	[illegible]	98 —100
[illegible]	[illegible]	6/-	W.India&PanamaTeleg.Co.,Ld.,Or.	10	[illegible]
34,563	10	[illegible]	[illegible]	[illegible]	[illegible]
4,669	[illegible]	[illegible]	[illegible]	10	[illegible]
£80,000	100	[illegible]	[illegible]	100	[illegible]
207,930	[illegible]	[illegible]	Western Telegraph Co., Ltd.	10	13½— 14*
£75,000	100	[illegible]	Do. 5%, Debs., 2nd Series	100	103 —105
518,945	Stk	[illegible]	Do. 4%, Deb. Stock, Red.	100	101½—103

VI.—SHIPPING COMPANIES.

[illegible]	[illegible]	[illegible]	[illegible] Ltd., 4½%, 1st Mort. Deb. Stk. Red.	[illegible]	[illegible]
40,000	10	5/6	Bucknall Steamship Lines, Ltd., [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Stk. Red. ..	[illegible]	[illegible]
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000 ..	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] 1st Mort. Deb. Stk. ..	[illegible]	[illegible]
1,200,000	1	[illegible]	Furness, Withy & Co., Ltd., Ord...	[illegible]	[illegible]
30,000	10	[illegible]	[illegible]	[illegible]	[illegible]
327,300	100	[illegible]	[illegible]	[illegible]	[illegible]
£150,000	Stk	[illegible]	[illegible]	[illegible]	[illegible]
55,000	5	1/3	Houlder Line, Ltd., Ord.	[illegible]	[illegible]
40,000	5	2/9	Do. 5½%, Cum. Pref.	[illegible]	3½— [illegible]
£200,000	Stk	4½%	Do. 4½%, 1st Mt. Deb. Stk. Red.	[illegible]	[illegible]
141,500	10	5/-	Leyland (Fredk.), & Co. (1900),Ltd., 5%, Cum. Pref. ..	[illegible]	[illegible]
£1,160,000	Stk	5%	Peninsular and Oriental Steam Nav. Co., 5%, Cum. Pref. ..	[illegible]	126 —129*
£1,160,000	Stk	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
£648,100	Stk	[illegible]	[illegible]	[illegible]	[illegible]
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Cum. "A" Pref. .	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Union Castle Mail Steamship Co., Ltd., Ord.	[illegible]	[illegible]
£1,0[illegible]	[illegible]	[illegible]	Do. 4%, Debenture Stk.,Red	[illegible]	100 —[illegible]

VII.—MISCELLANEOUS COMPANIES.

[illegible]	[illegible]	9/4	Chadburn's (Ship) Tele. Ltd., Ord. .	[illegible]	[illegible]
[illegible]	[illegible]	5%	General Hydraulic Power Co., Ltd.	[illegible]	[illegible]
12,500	[illegible]	10/-	Oakey (John) and Sons, Ltd., Ord..	1	[illegible]
[illegible]	[illegible]	6/3½	Power Gas Corp., Ltd., Ord., Nos. [illegible]	[illegible]	[illegible]
66,462	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	6d	Waygood (R.) & Co., Ltd., Ord. ..	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Do. [illegible]	[illegible]	[illegible]

RAILWAY CARRIAGE & WAGON COMPANIES.

Subscribed				Paid up	
[illegible]	[illegible]	[illegible]	[illegible] 1-10,000	10	21 — 21½
8,739	10	[illegible]	[illegible]	1	[illegible]
[illegible]	[illegible]	6/-	Do. Cum. Pref. 6%, 1-10,000 .	[illegible]	13 — [illegible]
[illegible]	[illegible]	7/	Gloucester Rail. Car & Wagon, Ld., [illegible]	7	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10,000	20	[illegible]	[illegible]	[illegible]	[illegible]

THE METAL MARKET.

PRICES IN 1904.

COPPER.

THE chart given to-day traces the history of copper for the year 1904. The lines which record the fluctuations in the price of this metal often tell a good deal more than mere variations in value. With the rise and fall in the price of copper is bound up many other things; tendencies of trades; the prosperity of particular industries; the hopes and fears of dealers on 'Change; the fate of corners; panics in the share market. In the main, however, the story of 1904 is a plain unvarnished tale.

The year opened with copper standing at about £58 15s., and a sudden drop to £55 15s. in the beginning of February saw the lowest price of 1904. This sharp fall coincided with the outbreak of hostilities in the Far East, and but for the reduced stocks of standard copper at the time, the fall would have been more severe. From thence onwards the market passed through a short period of restricted operations, accompanied by extreme sensitiveness, but the average price of the metal for many months was about £57. The large shipments from the States effectually prevented any rise in quotations, while the bears were timorous of a squeeze if they attempted to depress prices. The falling off in American consumption was really the key of the position, for America, by virtue of producing 50 per cent. of the world's copper, dominates the situation. It will, perhaps, be interesting to note that while last year's production of copper, was 566,000 tons, this year's production will approach 600,000 tons. This is double the output of ten years ago, but consumption has kept pace with the great rise in tonnage produced, and the statistical position in Europe, at all events, shows that the market has generally the smallest backing of reserves. Indeed, the visible supply latterly has been equal to no more than a bare fortnight's consumption, although the latest figures show an increase in the stocks held. The pivot on which our market turns is therefore American shipments, and a hint of a falling off in this respect at the end of September last started the rise in copper which has characterised the past three months' operations. A bull movement was speedily developed, and the price of the metal rose almost without a halt to £67 2s. 6d., which was the highest price attained since 1901, when copper touched £72. There were many who predicted that the present year would see copper in the 70's again. Sensational developments in the share market, however, and the improvement in the statistical position noted above had a reactionary effect, and until the last few days the tendency was uncertain. The latest movement is, however, towards higher prices, a strong bull movement having been developed, which has put copper to the highest prices of the year.

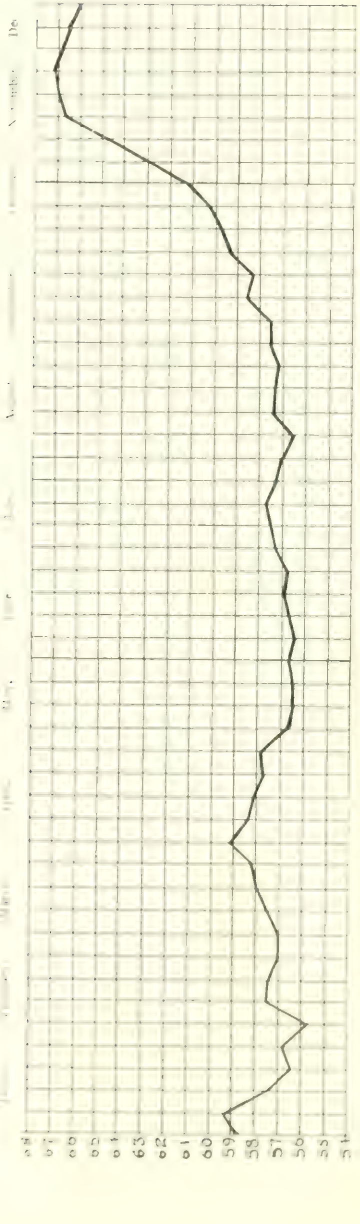
TIN.

The movements of tin during the year have been invested with considerable interest, and the fluctuations have been within such comparatively wide limits that it will be instructive to briefly discuss reasons therefore. There is little difference between the opening and closing prices of the year, but between the two, the chart shows a great gulf fixed, in which tin stood at under £119 per ton. The decline which set in during the early weeks of the year was in the nature of a slump. It was mainly due, as readers will remember, to the coincidence of large shipments from the Straits and diminished consumption in the United States, and by the end of February the quotation for tin was £10 below the opening price of the year. The recovery which took place in March was quite short lived, a stale bull account with free bear selling of forward metal holding the market down, although the quotation did temporarily touch £130.

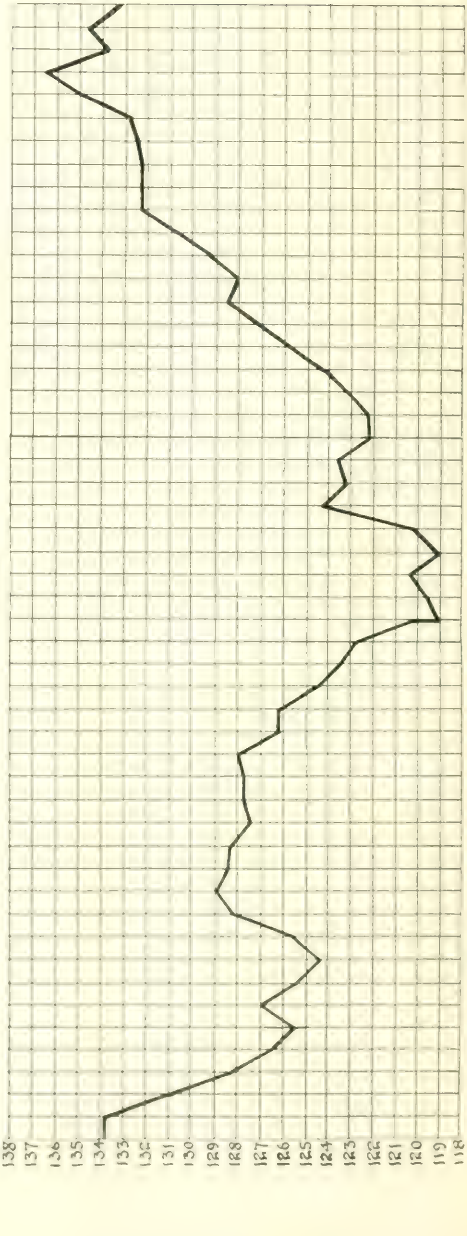
The shipments from the Straits continued on a large scale, and the publication of the Banca figures for 1903–1904 at 204,000 piculs, published at the end of April, were calculated to induce realisation. May saw a determined attempt to effect a bear squeeze, but the movement met with little success, and the "shorts" soon regained control, and assisted by the reports of smaller consumption in June they put the price down to the lowest point of the year £118 2s. 6d., a figure not shown in the chart, which is based on the highest prices of each week.

From this point there was an almost uninterrupted rise to the highest quotation of the year, £137. The improvement in trade during the second half of the year, when tin plate makers were unusually active,

COPPER.



TIN.



Based upon [illegible] Weekly [illegible] revealed a scarcity of cash metal, and quotations rose rapidly, the rise being assisted by a scramble on the part of the bears to cover their commitments.

Leaving history, and turning to discuss the general question, a careful estimate of the world's production of tin for 1904 leads to the conclusion that for the first time for many years there will be a decrease in the total production. The increased supply from the Malay States has been reckoned at about 1,000 tons; there should be a small increase in the Bolivian output, while the Australian shipments for eleven months show an additional 200 tons. Against this small addition to supplies is to be set the heavy decrease in the output from the Dutch East Indies. Viewed from this standpoint, the opening up of new sources of supply in Malay, Burmah, South Africa, and Alaska is opportune, although it will of course, take time for the effect to be felt in the market. With an improving demand and a scarcity of cash metal, which are the distinguished features of the present situation, it appears probable that the early months of the year will witness a further improvement in the price of tin.

IRON AND STEEL.

In the iron and steel trade 1904 will not be reckoned among the good years, although it is satisfactory to record that conditions presage a period of improving business. The chart deals with the quotations for pig iron; Scotch, Cleveland, and Hematite, and taking a broad view of the position it will be noted that the trend of prices has been generally upwards. In January the speculative market was flat on an increase in Middlesbro' and Scotch stocks, but the end of the month saw a better tendency, Cleveland warrants rising to 42s. 6d. During February the speculative interest in pig iron broadened out, and more activity prevailed on the London and Glasgow Exchanges. The irresolution which quotations displayed subsequently was due, as pointed out by Merton and Co., to the curious reports from the United States with regard to iron and steel, for while the demand for steel was better and prices showed an inclination to stiffen, pig iron was distinctly weak. The market then entered on a period of dullness, but bed rock prices for foundry iron in America were reached in March. The end of the first quarter of the year gave signs of improving trade, and Middlesbro' advanced to over 44s. with corresponding rises in Hematite and Scotch.

The Birmingham quarterly meeting in April gave fresh evidence of the more satisfactory position of iron and steel, but the next movement in the market was downward, and was due mainly to cheap offers of American pig on the Continent, the result of trade depression in the States. The speculative markets continued to reflect the unsatisfactory general conditions, and no improvement took place until the beginning of October, when, owing to the more favourable reports from America, the speculative market here broadened out. From thence until the present time the industrial position has gradually improved, and the quotations for pig iron have steadily advanced.

The last weeks of the year have seen, indeed, a feverish speculation in Middlesbro' iron. The bull element took control of the position, and statistics were disregarded, although they disclosed a very sensible increase in the visible supply. The latest view of the position shows the speculative market somewhat unsettled owing to liquidation, but prices, although they have fluctuated rather widely, are higher on balance, and the year closes with quotations at their highest point. The outlook, too, is brighter all round; trade reports are satisfactory; the American situation is sound, and the expectations of good trade in the coming year appear to be fairly well founded.

LEAD AND SPELTER.

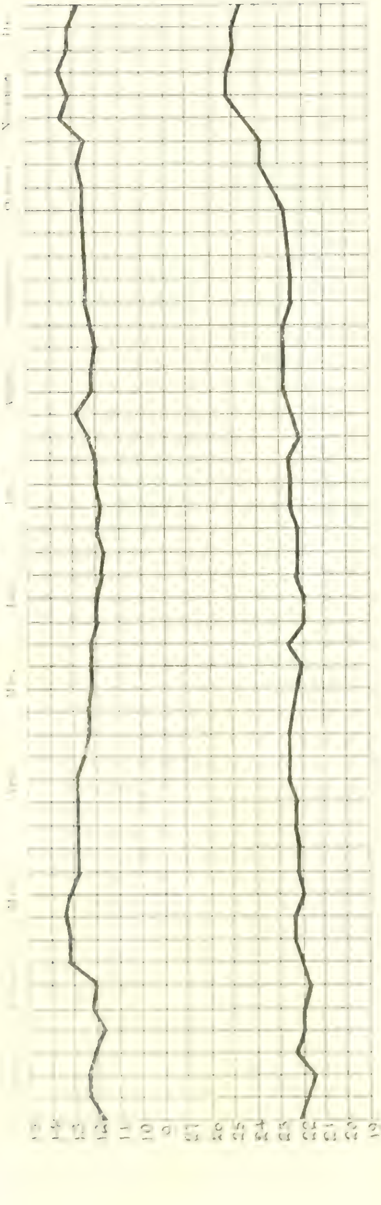
The lead market has pursued an uneventful course during 1904. The quotation at the beginning of the year was £11 10s. for foreign, and £11 12s. 6d. for English, and to-day's price is about £13, while the limits of fluctuation have been extremely narrow as whenever the demand was such as to suggest a rise in quotations, the metal came on offer, and depressed prices.

The outbreak of hostilities in the Far East induced the belief that following precedent, lead would go higher, and in February, consumers came forward and cleared the market. Those who looked for a sharp rise were, however, disappointed, the improvement in values having been an extremely slow process. It was not until March that lead was able to maintain its quotation at £12 or over.

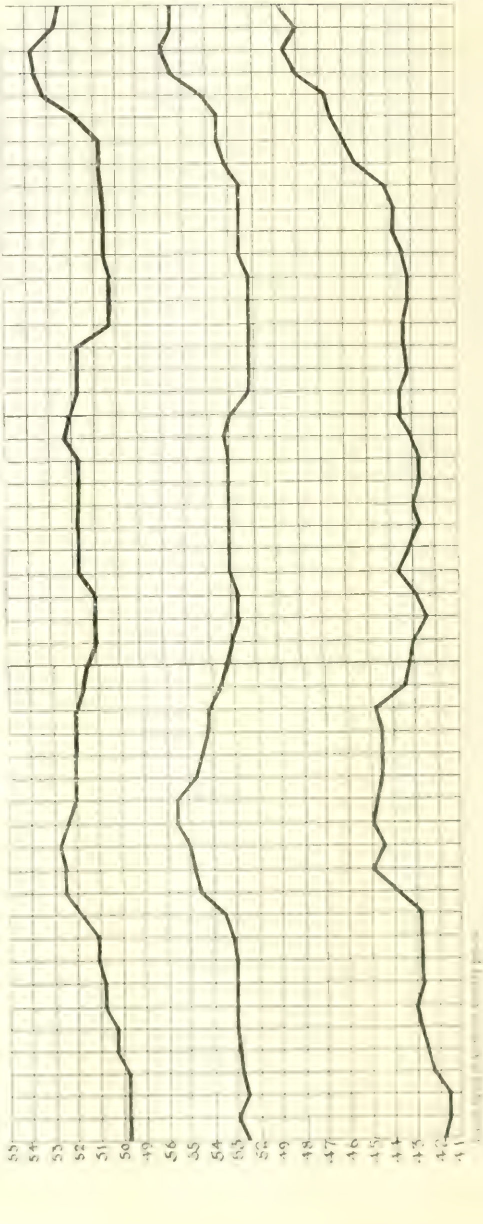
May saw another period of dull markets, and depressed prices, the majority of consumers holding back in the belief that they would be able to buy cheaper.

During the first half of June the arrivals of foreign lead in London were unprecedentedly heavy, and large offers of spot metal assisted the decline in quotations. Lead remained under a cloud until the last quarter of the year, when, taking advantage of the improvement in the statistical position, holders have been very reserved, demanding higher prices after each sale. The rise latterly has been assisted by some speculative operations in forward metal.

Spelter has been an interesting market, and the chart brings out the fluctuations in price during the past



LEAD AND SPELTER.



PIG IRON: SCOTCH, HEMATITE, CLEVELAND.

year. The close of 1903 saw an improving market, and the rise continued into January. Many anticipated a further sharp rise, but the market quieted down. The position, however, remained strong, owing to shortness of supplies. The buying, notwithstanding, was not on the scale expected, and the cut in prices in the galvanised iron trade made consumers chary of ordering beyond actual needs. Continental dealers in the early part of the year too, sold somewhat freely, and the combination of these things kept the market steady, the average price for the first quarter of the year being about £22 5s. In April, however, Continental producers found themselves sold out and a larger inquiry for spelter ensued.

The upward movement thus initiated has continued to make steady progress during the second half of the year, and but for large imports of American spelter, quotations would undoubtedly have seen a still higher level. Consumption is rapidly increasing, and production, although larger, does not keep abreast of demand. Latterly, too, the improvement in the galvanising trade has led to larger purchases from those engaged in the industry, and as the imports of American spelter are on the decline, owing to the rise in prices on the other side, it is difficult to see what is to prevent the rise going to limits which one hesitates to predict.

OBITUARY.

The news of the death of the Rev. J. M. Bacon, the well-known balloon expert, has been received with general regret. Mr. Bacon was, by common consent, the leading scientific aeronaut in England. His latest experiments had for their object the construction of a safe and effective hot-air balloon.

The death is announced of Mr. John Grace, of Messrs. Dean, Smith, and Grace, Ltd., lathe manufacturers, Worth Valley Tool Works, Keighley. Mr. Grace took a keen interest in local affairs.

The death is announced of Mr. Elijah Helm, secretary to the Manchester Chamber of Commerce, at the age of 67. He was born at Padiham, near Burnley, and received his early education at Hoole's Academy, Blackburn, where Mr. John Morley was also a pupil. He was engaged in the cotton trade until 1890, when he succeeded Mr. Fox Turner as secretary to the Chamber of Commerce. Mr. Helm was an ardent student of political economy, and a prolific writer and frequent lecturer on commercial subjects. Some years ago he was an active bi-metallist.

The death of Colonel Frederick Cunningham Corfield, the manager of the Butterley Colliery, has removed not only a figure well known in the trade, but a man who played a prominent part in municipal public life

IGNITION APPLIED TO INTERNAL COMBUSTION ENGINES.

Sir Oliver Lodge recently lectured to the Automobile and Cycle Engineers' Institute on this subject.

His introductory remarks dealt with the general principles governing the ignition of an inflammable gaseous mixture. He pointed out that such ignition involved the raising of the mixture to a certain critical temperature locally, and that combustion then spread from this ignition centre. The spreading was influenced by the concentration of the mixture—that was, the proportion of combustible to incombustible molecules, by its state of compression, and by its temperature. Since also the molecules of different gases had different rates of motion, the lightest moving fastest, the predominance of the lighter constituent also favoured spread of combustion. In such a mixture the rate of combustion became so rapid as to be explosive, because many molecules came within the influence of the ignition centre, but in a weak one, owing to the comparative fewness of combustible molecules, the spread of combustion took a meandering course, or might fail altogether. To increase the rate in a weak mixture compression would be resorted to, and it would be fired at several points simultaneously. The speed of combustion was also affected by the contiguity of cold surfaces, such as the walls of the cylinder in a gas engine; the result was to extinguish the combustion to a certain extent, and there was bound to be some unburnt material. Hence it would be better to work with hot walls if possible, and he wondered whether a century hence engineers would still be using water-jacketing. He thought the use of hot materials was not outside the possibilities of invention, and the present system seemed to him a mistake like that of the Newcomen engine, in which everything was cooled down at each stroke. He then proceeded with the aid of a number of lantern slides to explain the advances that had been made in the methods of ignition. He first showed some of the older methods, in which a flame, a hot wire, an incandescent tube, etc., were employed, and then discussed electrical devices, in the first place, those using low tension currents, and then those that employed the high tension current of an induction coil. Finally he described a method which depended on insertin in the circuit a pair of Leyden jars.

SELECTED PATENTS.

[illegible] Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C., [illegible]

[illegible]

NEW PATENTS APPLIED FOR.

[illegible]

27,040. W. H. Gordon, London. [illegible]

27,041. T. S. James, London. [illegible]

27,042. T. S. James, London. [illegible]

27,045. J. W. Smith, London. [illegible]

27,048. J. B. Evans, Kingston-on-Thames. [illegible]

27,073. C. Wedge, London. [illegible]

27,081. W. I. Twombly, London. [illegible]

27,088. J. H. Pickavance, London. Dec. 12th.—Improve- [illegible]

27,101. G. Westle, London. Dec. 12th.—Improvements in [illegible]

27,164. V. H. Gregory, London. Dec. 13th.—Improve- [illegible]

27,193. G. S. Huess, London. Dec. [illegible]

27,241. W. J. Greaves, Barnes. [illegible]

27,248. Societe Anonyme du Temple, London. [illegible]

27,261. J. A. Fletcher and H. Wilcock, London. [illegible]

27,280. A. Craig, Coventry. [illegible] Improvements in or [illegible]

27,286. The British-Thomson-Houston Co., Ltd., London. [illegible]

27,295. T. Thomson, London. Dec. 14th.—Improvements [illegible]

27,311. G. Stocks, Huddersfield. Dec. 15th.—Improved [illegible]

27,324. A. J. Cooper, Liverpool. [illegible]

27,331. J. B. Butterfield, Leeds. [illegible]

27,339. B. Hiernaux and H. Laviolette, London. [illegible] submitted to inner pressures.

27,368. W. H. Longsdorf, London. Dec. 15th.—Improve- [illegible]

27,393. H. L. Davies, London. [illegible]

27,394. C. Bellens, London. [illegible] relating to steam generators. (Date applied for, January 7th, 1904.)

27,441. E. Hannemann, Germany. [illegible]

27,452. W. W. Shilling, London. [illegible]

27,458. O. Meredith, Cheshire. [illegible]

27,485. R. Aitken, London. [illegible]

27,488. J. G. Stidder and J. E. Cooper, London. Dec. [illegible]

27,539. J. Woodside, London. [illegible]

27,541. F. Seiffert, London. Dec. 16th.—Improvements in [illegible]

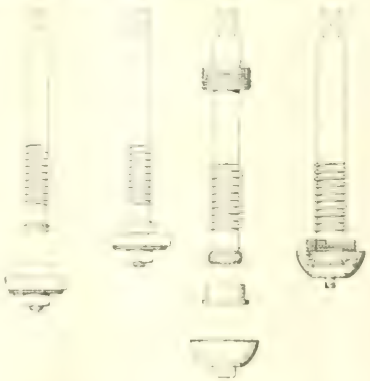
27,567. F. Shaw, Halifax. [illegible]

27,572. J. Gresty, Lancs. [illegible]

RECENT SPECIFICATIONS.

VALVES.

Isaac Storey and Sons, Ltd., and C. Ely, Manchester. [illegible] the flow of fluids, and relates particularly to screw-down valves, lift valves and other valves having a valve or clack connected to the valve spindle. This invention relates to a ready means for effecting a connection between the valve spindle and the valve or clack, and this without any drilling or boring and without the use of any loose fastenings. The valve spindle is formed with a collar or enlargement



or with a suitably shaped extremity and in conjunction therewith is [illegible] extension is formed on a part to which the valve is secured. In connecting valve spindle and said part carrying the cylindrical exten- [illegible] the collar or extremity. The forms of connection allow of the spindles being turned up fr[illegible] [illegible] tate the [illegible] of special castings with [illegible]

STEAM ENGINES.

Clarke, Chapman and Co., Ltd., and W A. Woodeson, Gateshead-on-Tyne. Oct. 1st, 1904.—Consists of improvements in that kind of means for distributing steam, water, or other actuating fluid in engines or motors in which the main inlet and exhaust passages for actuating fluid are opened and closed suddenly by means of a piston by the live steam itself under auxiliary-valve control mechanically effected by the engine. The objects of the invention are to provide means wherein the main and auxiliary valves are cylindrical or other oscillatory valves, and the construction and arrangement are such that the piston will be mechanically moved simultaneously with the auxiliary-valve actuation until brought into position for being shot across by the steam. The means comprise a valve chest provided with ports and passages, an oscillatory main valve and the piston adapted to be mechanically connected to the main valve and adapted to operate it under the action of actuating fluid. Auxiliary oscillatory valves are employed for controlling the passage of the actuating fluid to and from the piston, and for the auxiliary valves a carrier is adapted to be rocked about the axis of the main valve by a moving part of the engine, and to move the main valve and its piston mechanically until the latter is in a position to be shot across by the actuating fluid: should it not be so shot across this means will cause it mechanically to open the main passages as required.

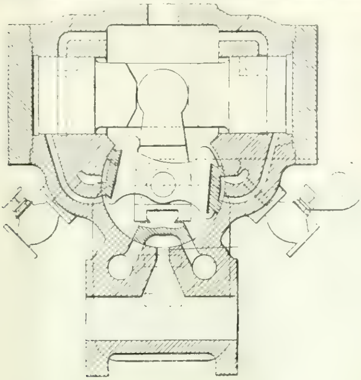


FIG. 1.

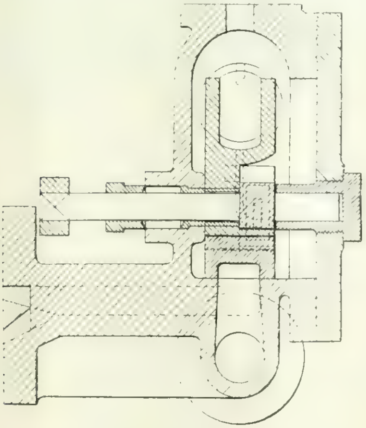


FIG. 2.

SHAFT COUPLINGS.

F. L. Croft, T. A. Perkins, F. Croft, and H. Lindsay, Bradford. Jan. 15th, 1904.—This invention relates to improvements in that class of driving shaft coupling in which a flexible or other elastic connection is made between the driving and the driven parts of the coupling by interlacing or interweaving a band or cord between a number of studs or other equivalent carried by the two portions of the coupling respectively. In this class of coupling it is usual to fix the studs in one part equidistant from the centre of the shaft than those of the other part. This invention consists in making the outer series of studs so that they can be withdrawn from either side. For this purpose studs are employed of round bars which may be the same thickness throughout, and they have a screw thread formed at each end. A sleeve or pipe is passed over each stud, one end of which abuts against the face of that part of the coupling to which it is attached, and the other bears against a nut screwed on the end of the stud, while a nut is screwed on the opposite end of the stud, which projects through the part of the coupling carrying these studs. The other ends of these studs may be connected together by an annular stay fixed between the ends of the sleeve and the outer nut, or they may be connected in pairs. In order to tighten the flexible connection between the two parts of the coupling after it is fixed and to take up any play, radially adjustable bearers to outwardly deflect the flexible connection running between the inner sides of the inner series of studs are used. These bearers are carried by radial screws screwed into the boss of the part of the coupling carrying the inner series of studs and fixed by set screws.

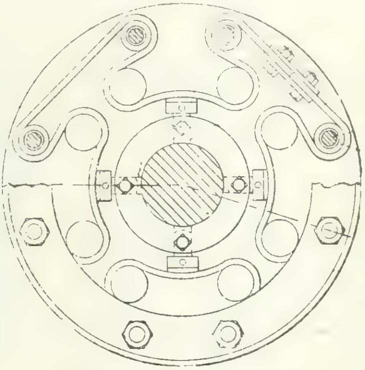


FIG. 1.

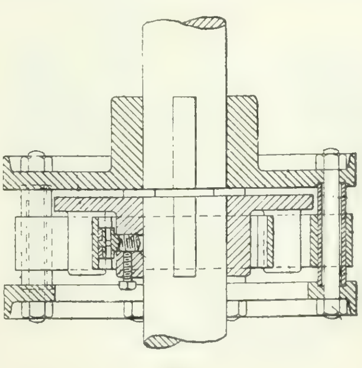


FIG. 2.

NEW PUBLICATIONS.

"ELECTRICITY CONTROL."

[illegible] By [illegible] Charles Griffin and Co., Ltd. 12s. 6d. net.

[illegible] rapid that it would seem practically impossible for any book on this extensive subject to be absolutely complete, but, bearing in mind the scope of the present volume, nothing of an essential nature appears to be omitted, and to a great extent it covers a ground as yet unattempted exclusively by any other work. The writer not only gives a succinct account of the best modern practice in switchgear design, but also devotes considerable space to descriptions of various kinds of unsuccessful apparatus, in many cases giving a concise explanation of the causes of failure, a feature which should prove of much value to the student. The writer recognises that the subject in its entirety is an inexhaustible one; he has therefore confined his attention to the control of that portion of the system between the generators and the distributing centre.

After discussing the general principles of switchgear design and constructional details, the author deals successively with circuit-breakers or current-interrupting devices, automatically operated circuit-breakers, alternating reverse current devices; arrangement of 'bus bars and apparatus for parallel running; general arrangement of controlling apparatus for high-tension systems; general arrangement of controlling apparatus for low-tension systems; examples of complete installations, and long-distance transmission schemes. The work is exceptionally well illustrated, and everywhere bears signs of painstaking research and careful experiment.

BOOKS RECEIVED.

[illegible] Maclean, M.A.D.Sc. Volume V. The Gresham Publishing Company. 9s.

Practical Engineer Pocket-Book. Leather, gilt, with Diary on ruled section paper. Technical Pub[illegible]

Practical Engineer Electrical Pocket-Book and Diary, 1905. Leather, gilt. Technical Publishing Company, Ltd. 1s. 6d.

Knotting and Splicing Ropes and Cordage. Edited [illegible]

The Metric Fallacy. By F. A. Halsey and Samuel S. Dale. D. Van Nostram Co., New York.

We have also received: "The Commission of H.M.S. [illegible] series. By G. R. Parker, with introductory article by Lionel Yexley. (The Westminster Press, Gerrards, Ltd.) A well-produced and most interesting little work, descriptive of life on a modern battleship; calculated to stimulate more general interest in the affairs of the Navy.—"Quick and Easy Methods of ascertaining the weights of Cast-iron and Steel." By Alfred Laycock (Milner and Co.! 1s. net.) The second edition of this handy and trustworthy compilation has been considerably enlarged, and now includes tables per lineal [illegible] 50 inches, also flats, cylinders, rings, balls, sheets, wire [illegible] We have already called attention to the general excellence of this work: the receipts, processes and memoranda for [illegible]

NEW CATALOGUES.

The Newall Engineering Company, Ltd., Warrington. The latest pamphlet received from this firm describes and illustrates their Measuring Machines, Limit and other Gauges, Micrometer, Surface Plates, etc. Particular attention is called to the Company's new Internal Micrometer. This instrument has three measuring points, which are hardened and ground on the outside ends to a spherical form, the diameter of the sphere being somewhat below the smallest diameter the tool is intended to measure. These three measuring points are operated by means of a micrometer spindle contained in the body. The conical end of this spindle comes in contact with the inner ends of of the three legs. As the spindle moves forward, so the three legs are thrust outwards until they come in contact with the sides of the hole that is to be measured. Fine springs keep the legs in contact with the conical end of the spindle. The thimble which operates the spindle is graduated to thousanths of an inch, and may be adjusted to take up wear. A useful pamphlet on "Limit and Limit Gauges" which contains tables of allowances for various classes of fits, and information valuable to engineers, can also be obtained on application to the [illegible]

Horace Marshall and Co., of 37, Basinghall Street, Leeds, send us a four-page reprint from "Machinery Market," entitled "Modern Foundry Equipment.—Some illustrated notes on New Labour Saving Appliances." Various kinds of moulding machines are described and illustrated, as are also core making machines, and pneumatic sand rammers and screen shakers.

Mr E. F. Jarvis, of Middlesbrough, forwards a booklet on Water Cooling, which describes and illustrates his "British" Water Coolers for refrigerating plants, condensing plants, gas engines, etc. We note that Mr. Jarvis put down the first cooling plant devised on the Continental system erected in this country, an illustration of which is shown. We have also received a leaflet describing Klein's Hand Piston-pumps.

Brush Bulletin, No. 7, is a handsome booklet issued by the Brush Electrical Engineering Company, Ltd., describing their Open and Enclosed Direct-Current Motors. Tables are included giving dimensions, speeds and outputs, prices, etc., and the latter part of the book is devoted to pictorial illustrations of the various applications of Brush Motors. This catalogue is punched ready for filing, and printed on art paper, a biscuit-coloured background showing the half-tone blocks to full advantage.

Messrs. W. H. Wilcox and Co., Ltd., 23, Southwark Street, S.E.—This firm's latest catalogue and price list comprises 400 pages, and is divided into sections as follows: Lubricating oils, beltings, packings, jointings, and general stores; steam engine fittings and boiler mountings, including "Penberthy" Patent injectors; pumps, hoses, tubes and other requirements for water and hydraulic purposes, including the "Wilcox" semi-rotary wing pumps, patent wire-bound suction and delivery hose, and "X-L" ejectors; tools and machinery, shafting, etc.; linemen's tools and electrical sundries. It is profusely illustrated, and being bound in limp cloth, makes a handy volume for shelf reference.

Messrs. Herbert Morris and Bastert, Ltd., of Empress [illegible] H M B [illegible] 41) containing many interesting illustrations.

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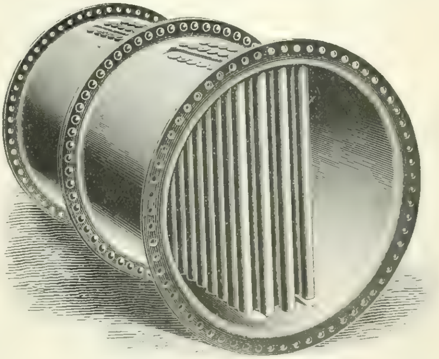

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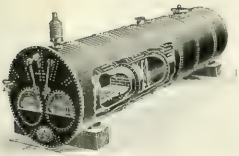

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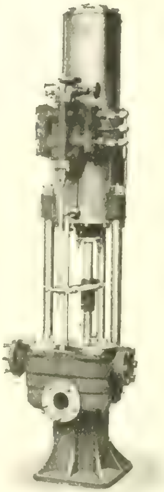

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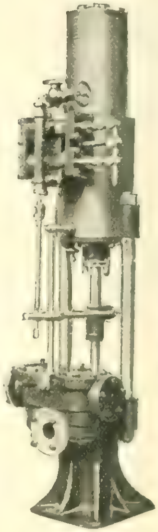

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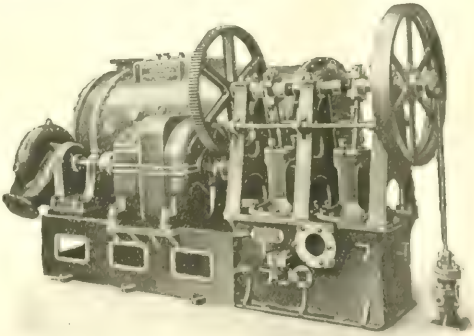

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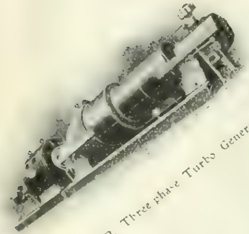

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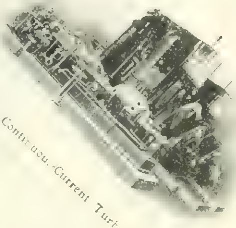

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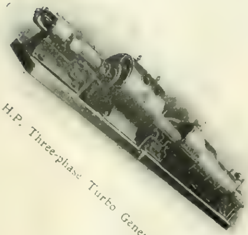

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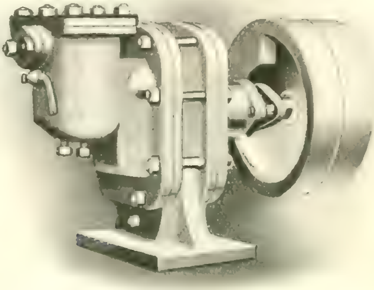

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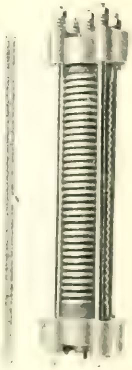

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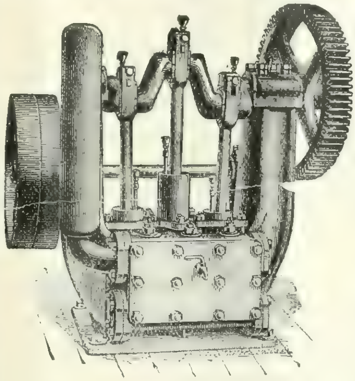

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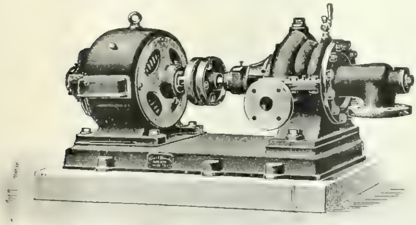

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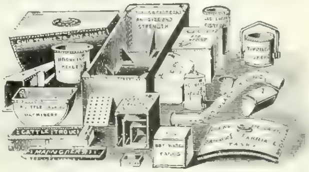

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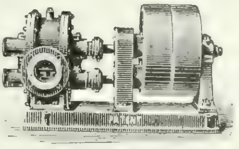

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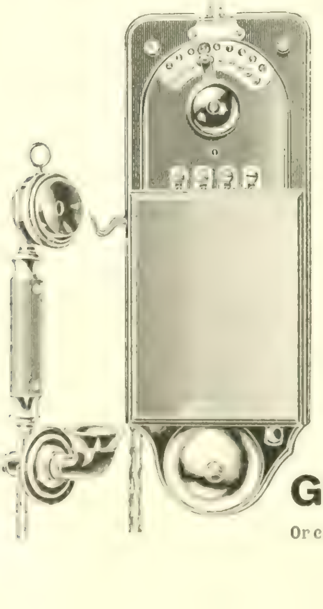

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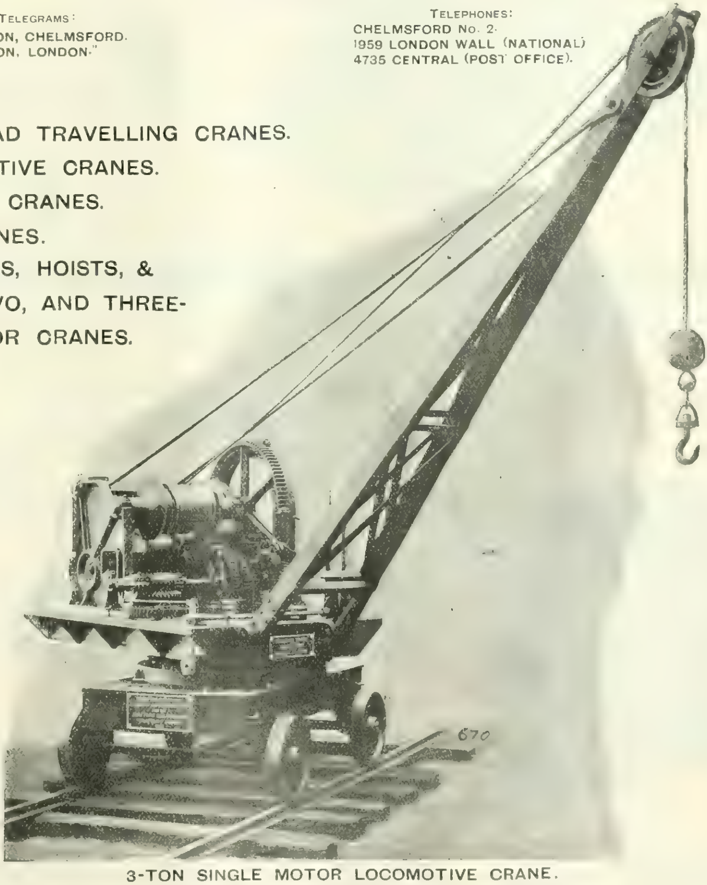

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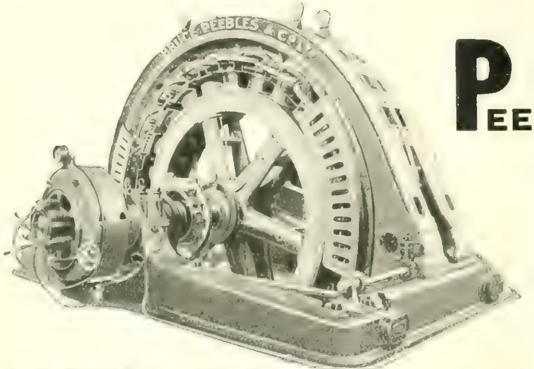

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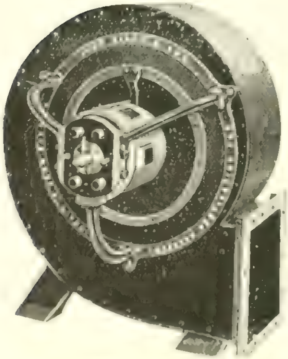

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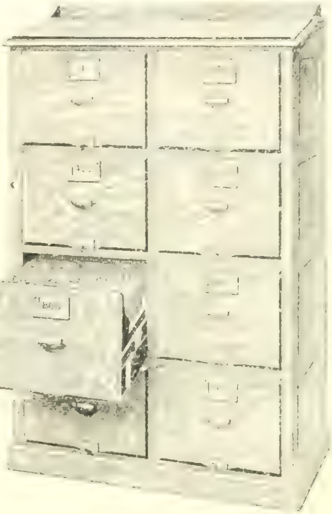

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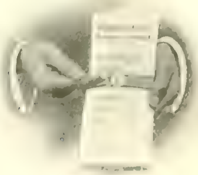

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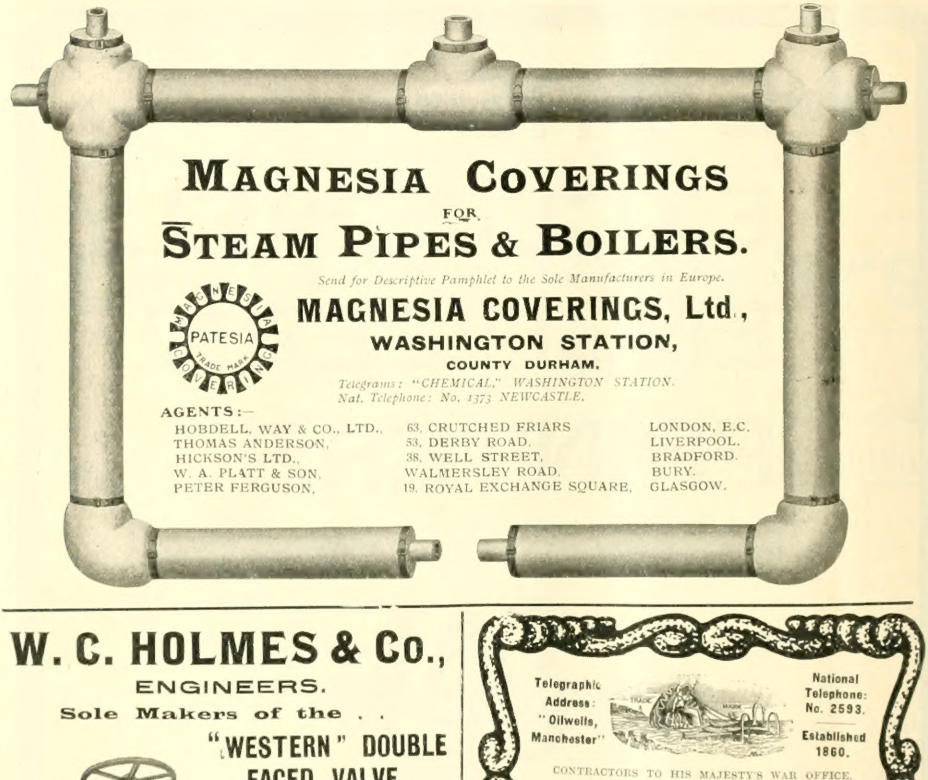

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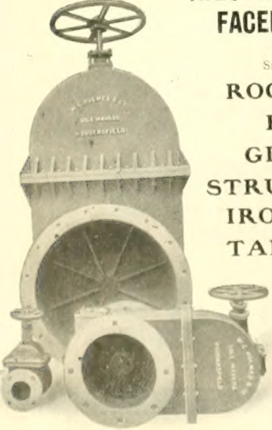

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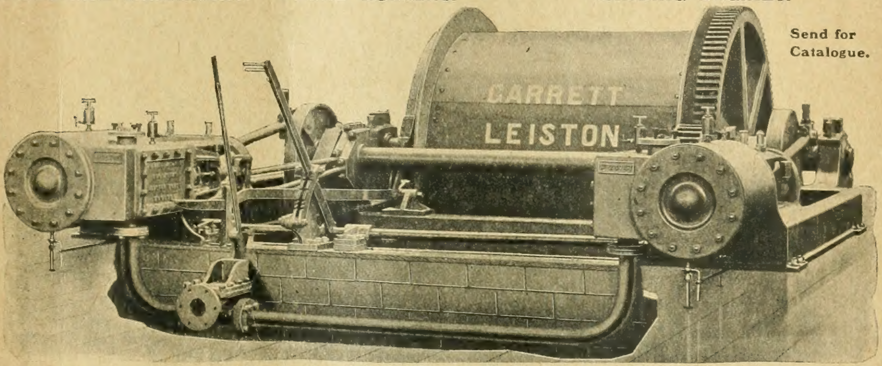

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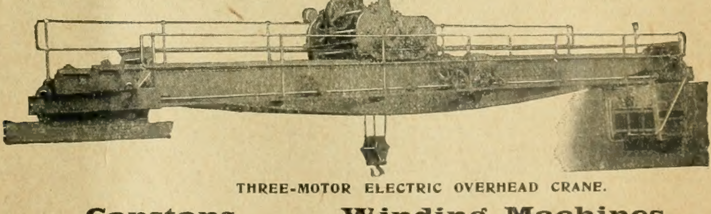

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